Issued March 1967

SOIL SURVEY

Roosevelt County, New Mexico

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1956 to 1960. Soil names and descriptions were approved in 1964. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1964. This survey was made cooperatively by the Soil Conservation Service and the New Mexico Agricultural Experiment Station; it is part of the technical assistance furnished to the Central Curry, Border, and Roosevelt Soil and Water Conservation Districts.

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Roosevelt County contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Roosevelt County are shown on the detailed map at the back of this report. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the report. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit and range site.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the section that describes the soils and from the section that discusses management of soils for cultivated crops and pasture.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Wildlife."

Ranchers and others interested in range can find, under "Range Management," groupings of the soils according to their suitability for range, and also the plants that grow on each range site.

Engineers and builders will find under "Soils in Engineering" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text.

Newcomers in Roosevelt County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "Additional Facts About the County."

Cover picture: A large area of Amarillo loamy fine sand, 0 to 3 percent slopes, in the Sandy Upland range site

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NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued March 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas-Eldorado Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF ROOSEVELT COUNTY, NEW MEXICO

BY W. JAMES ROSS AND ORAN F. BAILEY, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY G. K. BRINNEMAN, DELLON N. COX, JOHN A. HUGHES, WARREN JOHNSON, JACK R. PIPES, W. JAMES ROSS, AND MILLARD T. TURNER, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE NEW MEXICO AGRICULTURAL EXPERIMENT STATION

ROOSEVELT COUNTY is located on the western edge of the southern High Plains, in the east-central part of New Mexico (fig. 1). A strip of land, 12 miles wide and 21 miles long, extending northward to the Quay County line, forms the panhandle. The total land area of the county is 2,455 square miles, or 1,571,200 acres.

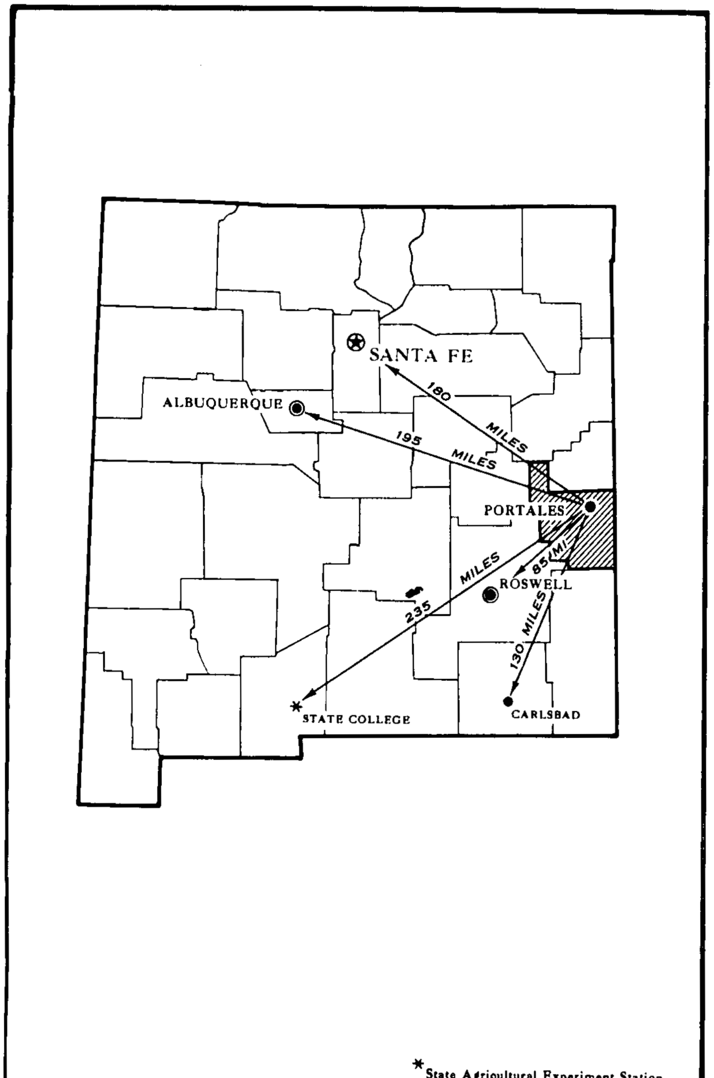

Figure 1.—Location of Roosevelt County in New Mexico.

Portales, the county seat, is on U.S. Highway No. 70, in the northeastern part of the county. A railway and several State highways go through Portales. This railway and U.S. Highway No. 60 cross the panhandle part of the county.

The climate of Roosevelt County is semiarid and is characterized by fairly cool winters, warm summers, light rainfall, and relatively low humidity.

The county has three general agricultural areas: dry-farmed areas, irrigated areas, and range land.

Most of the dryland farms are in the eastern half of the county. Many of the dairy farms are also in this area. The principal dryfarmed crops are wheat, grain sorghum, and broomcorn.

Water for irrigation is derived entirely from the underground water storage basin through the use of pumping units. This type of farming is confined mainly to the shallow water basin of the Portales irrigated area. (See figure 13, p. 20.) The irrigated farmland within this basin makes up about 50,000 acres. Other irrigated areas in the county include about 7,000 acres in the vicinity of Causey and Lingo and about 8,000 acres around the fringe of the Portales irrigated area. The principal irrigated crops are peanuts, sweetpotatoes, cotton, onions, grain sorghum, and alfalfa. The livestock in these areas consists mainly of milk cows and feeder calves.

Range land is confined principally to the extreme southern part and the western half of the county. These areas are described in detail in the section "Range Management."

Roosevelt County is in three soil and water conservation districts. About 160,000 acres in the panhandle is in the Central Curry, about 218,000 acres in the southwestern part is in the Border, and the rest of the county, or about 1,200,000 acres, is in the Roosevelt Soil and Water Conservation District.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Roosevelt County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen and perhaps some

they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Arvana and Clovis, for example, are the names of two soil series in Roosevelt County. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Clovis loamy fine sand and Clovis loam are two soil types in the Clovis series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Arvana fine sandy loam, 0 to 1 percent slopes, is one of several phases of Arvana fine sandy loam, a soil type that ranges from level to gently sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help greatly in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed and occur in individual areas of such small size that it is not practical to show them separately on the map. Therefore, such an area is shown as one mapping unit and is called a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Tivoli-Arch complex.

Occasionally, two or more recognized soils, which are not regularly associated geographically, may be mapped as a single unit, if their differences are not significant to the purpose of the survey or to soil management. Such a unit is called an undifferentiated mapping unit. A good example is Mansker and Portales loams, 1 to 3 percent slopes.

Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water, or so disturbed by man that they are not identifiable as soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Riverwash or Rough broken land, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only a part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. On the basis of the yield and practice tables and other data, the soil scientists set up trial groups, and they test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the five soil associations in Roosevelt County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map

is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The relationship of soil patterns in Roosevelt County to the topography is shown in figure 2. A description of each of the five associations follows.

1. Amarillo-Clovis loams association

Deep and moderately deep hardland

This association is known locally as wheatland country, or if used for range, as hardland, loamy upland, or shortgrass range. It covers about 25 percent of the county and consists mainly of deep and moderately deep, nearly level or gently sloping, medium-textured soils that form a belt, 6 to 12 miles wide, across the central part of the county. One small area occurs west of Floyd, and three small areas are in the northern part of the panhandle.

The Amarillo and Clovis soils, which are dominant, have a loamy surface layer and are hard when dry. They have a sandy clay loam subsoil and are underlain at a depth of 20 to 36 inches or more by soft caliche. The Olton-Zita loams are of minor extent and occur only in the panhandle. Other minor soils are the moderately deep Stegall soils, which are underlain by hard caliche, and the shallow Potter and Mansker soils.

The soils in this association generally are resistant to damage by wind if they have an adequate cover of crop residues or if they are not overgrazed. Terracing the gentle slopes and farming on the contour help to conserve moisture and to control water erosion.

Most of the wheat produced in the county is grown on the soils of this association. These soils have good moisture-holding capacity and can be used for irrigated crops.

2. Amarillo-Clovis fine sandy loams association

Deep and moderately deep, moderately sandy land

This association is known as moderately sandy row-crop land if cultivated, and, if used for range, is generally referred to as sandy upland. The vegetation on the range consists mostly of mid and short grasses. This association covers about 20 percent of the county and is widely scattered. One large area extends from east to west through the central part of the Portales shallow water basin and south of Floyd. Other relatively large areas are north of Rogers and west of Causey.

The Amarillo and Clovis fine sandy loams, which are dominant, have a slope range of 0 to 3 percent. These soils have a subsoil of sandy clay loam and are underlain by soft caliche at a depth of 20 to 36 inches or more. Of minor extent are the Arvana soils, which are underlain at a moderate depth by hard caliche, and the Mansker and Portales soils, which are shallow.

The soils of this association are more susceptible to wind erosion than the medium-textured soils of association 1. Runoff is slight, and internal drainage is good.

Management of grazing will help to reduce the hazard of wind erosion on the range sites. If cultivated, the soils should be farmed on the contour, and they need a protective cover of plant residues, good water management, and adequate applications of fertilizer. Wheat and grain sorghum are the principal dryfarmed crops. Sweetpotatoes, peanuts, and alfalfa are the main crops grown under irrigation.

3. Amarillo-Clovis loamy fine sands association

Deep and moderately deep sandy land

This association is referred to as sandy row-crop land if cultivated and sandy upland if used for range. It occupies about 30 percent of the county and consists of level and gently sloping or undulating soils. One relatively large area is in the vicinity of Delphos. Another is west of Delphos and extends in a west-northwest direction. Near the town of Highway and extending for the most part westward is a third strip about 6 to 8 miles wide. A fourth fairly large area occurs between the sandhills and extends east and west of Milnesand. Other areas are scattered throughout the county. The Amarillo and Clovis soils are dominant in this association.

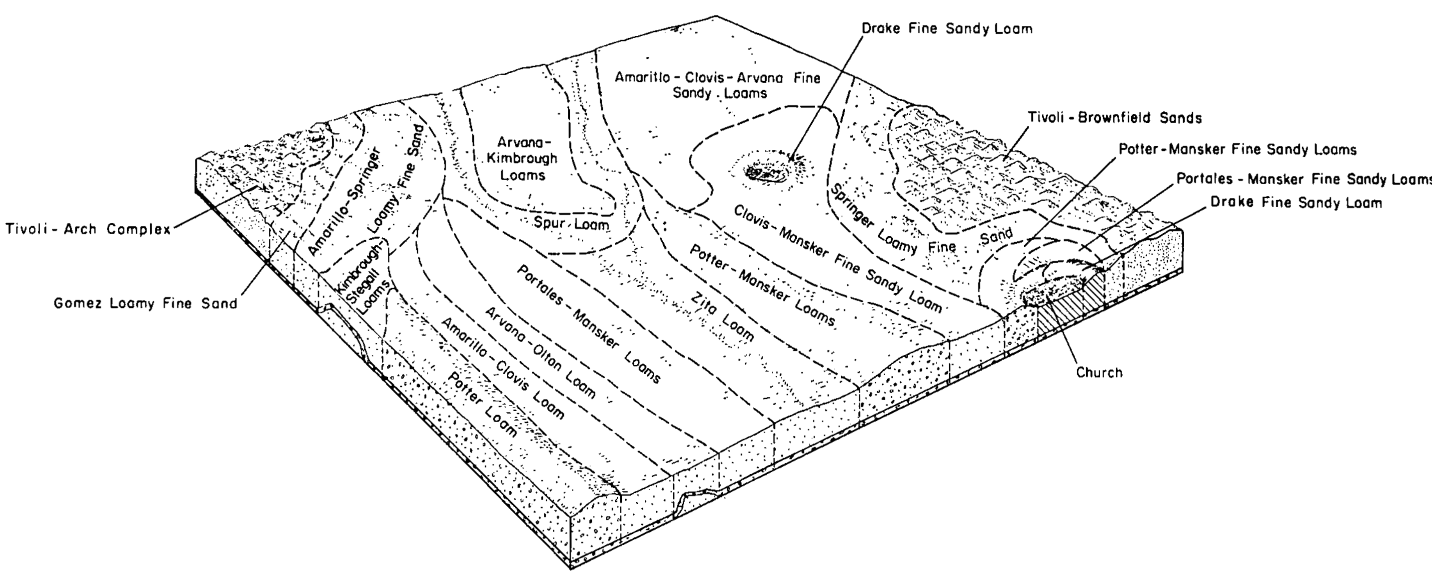

Figure 2.—**Generalized diagram of soil patterns that extend southwest to northeast through Roosevelt County.**

This association includes both deep and moderately deep soils that have a coarse-textured surface layer and sandy clay loam subsoil. Soft caliche occurs at a depth of 20 to 36 inches or more. The Arvana loamy fine sands are minor soils in this soil association. These soils are underlain at moderate depth by a layer of hard caliche. The permeable, coarse-textured Springer soils are other minor soils.

Wind erosion is a serious hazard in cultivated fields. Good stands of mid grasses can be expected on the range, but careful stocking is needed to prevent overgrazing. Otherwise, the range will be damaged by wind erosion.

Sorghum and broomcorn are grown if these soils are dryfarmed. Sorghum, sweetpotatoes, and alfalfa are the principal crops under irrigation.

4. Tivoli-Springer-Brownfield sands association

Deep, loose sandy land

Locally, this association is known as the sandhills. It covers about 15 percent of the county and consists of rolling, dunelike hills that occur in widely separated areas. One area is north of Portales and extends both eastward and westward to the county lines. This area consists mainly of Tivoli and Springer soils but includes the less sandy, shallow Arch and Potter soils. Another fairly large area is in the southern part of the county. This area occupies narrow strips that extend from east to west, north and south of Milnesand. This area is made up mainly of Tivoli and Brownfield soils. The Springer soils are the minor soils in this area.

Most of the soils of this association are deep. Their surface layer is coarse textured and ranges from 8 to 10 inches in thickness in the Springer soils to as much as 24 inches in the Brownfield soils. The Tivoli soils are coarse textured throughout and are very rapidly permeable. The Arch and Potter soils are shallow and are underlain by soft and hard caliche, respectively.

Numerous barren dunes dot this association. The soils are highly susceptible to wind erosion and generally cannot be cultivated successfully. If carefully managed, they are capable of supporting a limited amount of vegetation for grazing.

5. Potter-Mansker association

Very shallow to moderately deep, calcareous soils

This association includes those soils commonly referred to locally as rocky soils, shallow soils, or chalky soils. The rocky soils consist of Potter and Mansker soils on convex slopes; the shallow soils represent soils of the High Plains escarpments; and the chalky soils represent those calcareous soils predominantly in concave areas or playas and on gentle slopes of the Portales Valley.

This association makes up about 10 percent of the total acreage of the county. The soils are limy and, except for the Portales soils, which occur to a minor extent in the association, they are shallow over hard and soft caliche. The Portales soil is calcareous but is moderately deep over soft caliche. The Arch, Drake, and Church soils are also minor soils in this association.

Except for the soils that occur in the Portales Valley, where water is available, few of these soils are suitable for farming. The soils that are irrigated produce fair to good yields of cotton, sorghum, and alfalfa.

Descriptions of the Soils

This section describes the mapping units in Roosevelt County. Following the name of each mapping unit, there is a code symbol in parentheses. This symbol identifies this mapping unit on the detailed soil maps at the back of this report.

In the section "Formation and Classification of Soils," there is a technical description of each soil series in the county and a description of a representative soil profile for each series. The profile described is considered typical of all the soils in the series. If a mapping unit differs from this typical soil, the differences are stated in the description of the mapping unit or are apparent in its name.

Some technical terms are used in describing mapping units simply because there are no nontechnical terms that convey precisely the same meaning. Many of the more commonly used terms are defined in the Glossary.

The acreage and proportionate extent of the mapping units are shown in table 1. At the back of this report is a list of the mapping units in the county and the capability unit and range site each is in. Also given is the page on which each capability unit and range site is described.

Amarillo loamy fine sand, 0 to 3 percent slopes (Aa).—This deep soil is extensive along the northern fringe of the Portales irrigated area and in the southern part of the county.

The coarse-textured surface layer rests clearly on a moderately permeable, medium-textured subsoil. Both the surface layer and subsoil are reddish brown and are noncalcareous. The subsoil, which begins at a depth of about 10 inches, is prismatic sandy clay loam and is about 40 inches thick (fig. 3). A pinkish-white, massive substratum, which begins at a depth of about 51 inches, varies both in texture and in thickness. It is strongly calcareous and contains fragments of hard caliche.

Included in the areas mapped are small areas of Clovis loamy fine sand, 0 to 3 percent slopes, and small areas of Arvana loamy fine sand, 0 to 3 percent slopes. The Clovis

Figure 3.—**Prisms from the subsoil of Amarillo loamy fine sand, 0 to 3 percent slopes.**

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent	Soil	Acres	Percent
Amarillo loamy fine sand, 0 to 3 percent slopes	127,480	8.1	Clovis loam, 1 to 3 percent slopes	18,959	1.2
Amarillo fine sandy loam, 0 to 1 percent slopes	63,757	4.1	Drake soils	16,836	1.1
Amarillo fine sandy loam, 1 to 3 percent slopes	25,104	1.6	Gomez loamy fine sand	31,112	2.0
Amarillo loam, 0 to 1 percent slopes	31,031	2.0	Hilly gravelly land	3,793	.2
Amarillo loam, 1 to 3 percent slopes	11,019	.7	Kimbrough fine sandy loam	10,768	.7
Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded	68,893	4.4	Kimbrough loam	16,018	1.0
Arch loamy fine sand	7,844	.5	Mansker and Portales fine sandy loams, 1 to 3 percent slopes	25,650	1.6
Arch fine sandy loam	7,711	.5	Mansker and Portales loams, 1 to 3 percent slopes	50,626	3.2
Arch loam	14,044	.9	Montoya clay loam	3,953	.3
Arch soils, severely eroded	11,430	.7	Olton loam, 0 to 1 percent slopes	24,678	1.6
Arvana loamy fine sand, 0 to 3 percent slopes	34,384	2.2	Olton-Zita loams, 0 to 1 percent slopes	10,839	.7
Arvana loamy fine sand, shallow, 0 to 1 percent slopes	416	(1)	Portales fine sandy loam, 0 to 1 percent slopes	31,255	2.0
Arvana fine sandy loam, 0 to 1 percent slopes	44,341	2.8	Portales loam, 0 to 1 percent slopes	40,172	2.6
Arvana fine sandy loam, 1 to 3 percent slopes	10,395	.7	Potter soils, 0 to 9 percent slopes	55,179	3.5
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	904	(1)	Riverwash	1,120	(1)
Arvana soils, 0 to 3 percent slopes, severely eroded	19,693	1.3	Rough broken land	3,915	.2
Berthoud sandy loam, 2 to 9 percent slopes	15,056	1.0	Springer loamy fine sand	86,993	5.5
Bippus and Spur soils	18,237	1.2	Springer soils, severely eroded	10,509	.7
Blackwater loam	1,393	(1)	Stegall loam, 0 to 1 percent slopes	79,661	5.1
Blown-out and dune land	17,634	1.1	Stegall loam, 1 to 3 percent slopes	13,598	.9
Brownfield fine sand	136,402	8.7	Stegall loam, shallow, 0 to 1 percent slopes	1,131	(1)
Brownfield soils, severely eroded	39,813	2.5	Tivoli fine sand	101,011	6.5
Church clay loam	5,469	.3	Tivoli-Arch complex	32,397	2.1
Church soils, severely eroded	122	(1)	Travessilla loam	1,004	(1)
Clovis loamy fine sand, 0 to 3 percent slopes	31,309	2.0	Zita fine sandy loam, 0 to 1 percent slopes	8,935	.6
Clovis fine sandy loam, 0 to 1 percent slopes	60,639	3.9	Zita loam, 0 to 1 percent slopes	3,890	.2
Clovis fine sandy loam, 1 to 3 percent slopes	20,586	1.3	Miscellaneous land [2]	10,357	.7
Clovis loam, 0 to 1 percent slopes	51,735	3.3	Total	1,571,200	100.0

[1] Less than 0.1 percent.
[2] Miscellaneous land includes gravel pits, intermittent lakes, roads, and farmsteads.

soil is moderately deep over soft caliche, and the Arvana soil is moderately deep over hard caliche.

Runoff is slow, internal drainage is good, and moisture is readily available for use by plants. This soil is highly susceptible to wind erosion because of the sandy surface layer. Water erosion is a moderate hazard on the stronger slopes.

If dryfarmed, this soil is best suited to broomcorn and forage sorghum. If irrigated, it can be used for grain sorghum, sweetpotatoes, and alfalfa. The range is productive of such mid grasses as little bluestem and sideoats grama. *Dryland capability unit IVe-4 if in climatic zone 3, and unit VIe-1 if in climatic zone 4; irrigated capability unit IIIe-10; Sandy Upland range site.*

Amarillo fine sandy loam, 0 to 1 percent slopes (Ab).—This deep soil occurs in slightly undulating, nearly level areas.

The surface layer is reddish-brown, noncalcareous fine sandy loam and is about 9 inches thick (fig. 4). The subsoil is moderately permeable, noncalcareous, prismatic sandy clay loam and is about 34 inches thick. It is underlain at a depth of about 40 to 48 inches by a lime zone.

This soil is associated with Clovis fine sandy loam, 0 to 1 percent slopes, and Arvana fine sandy loam, 0 to 1 percent slopes, both of which are moderately deep.

Runoff is slow, internal drainage is good, and the water-holding capacity is high. Water enters this soil easily, and the moisture stored is readily available for plant use. This soil is only slightly susceptible to water erosion but is moderately susceptible to wind erosion.

Peanuts, sweetpotatoes, cotton, and grain sorghum are the principal crops grown under irrigation. Wheat and grain sorghum are suitable if the soil is dryfarmed. Good to excellent stands of mid and short grasses are possible in areas that are used for range. Little bluestem, sideoats grama, and blue grama are dominant in the plant stand. *Dryland capability unit IIIe-1 if in climatic zone 3, and unit IVe-1 if in climatic zone 4; irrigated capability unit IIe-2; Sandy Upland range site.*

Amarillo fine sandy loam, 1 to 3 percent slopes (Ac).—This soil occurs throughout the county, but the total acreage is not large.

Both the surface layer and subsoil are reddish brown and noncalcareous. The surface layer is about 10 inches thick, is very friable, and has weak granular structure. The subsoil is about 40 inches thick, and it has moderate prismatic structure. This layer is moderately permeable to air and water. It is underlain by a strongly calcareous, soft, pink, limy substratum that varies in thickness and that contains many fragments of hard caliche.

This soil is associated with the moderately deep, calcareous Mansker and Portales fine sandy loams, 1 to 3 percent slopes. Small areas of the moderately deep Clovis fine sandy loam, 1 to 3 percent slopes, are included in the areas mapped.

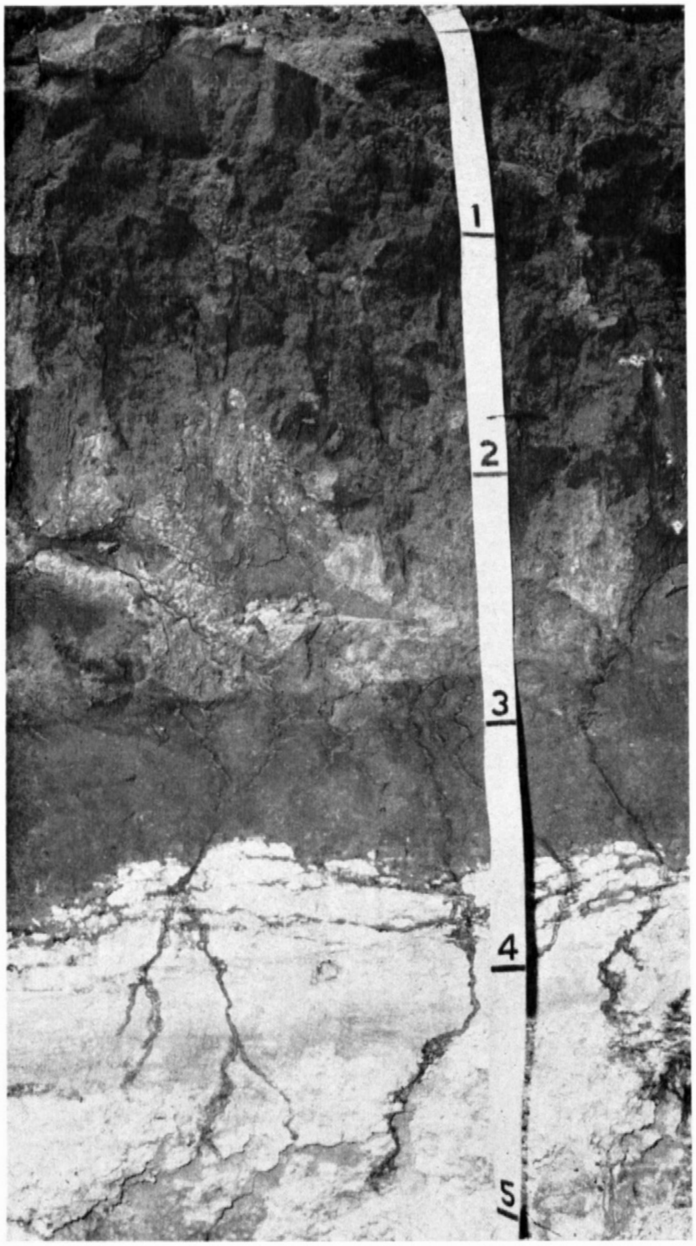

Figure 4.—**Profile of Amarillo fine sandy loam, 0 to 1 percent slopes.**

The Amarillo soil has good internal drainage and moderate runoff. It takes water well and is capable of storing large amounts for plant use. It is moderately susceptible to both wind and water erosion.

If irrigated, this soil is productive of peanuts, cotton, sweetpotatoes, small grain, and grain sorghum. As dry cropland, it is suited to grain and forage sorghum. A limited acreage can be used for wheat during years of favorable seasonal moisture. The range is productive of both mid and short grasses. *Dryland capability unit IIIe-1 if in climatic zone 3, and unit IVe-1 if in climatic zone 4; irrigated capability unit IIIe-4; Sandy Upland range site.*

Amarillo loam, 0 to 1 percent slopes (Ad).—This deep, medium-textured soil occurs in smooth, nearly level areas.

Both the surface layer and subsoil are reddish brown. The surface layer consists of about 10 inches of noncalcareous, friable, granular loam. The subsoil, which ranges from 30 to 40 inches in thickness, is noncalcareous, prismatic sandy clay loam. It grades to a strongly calcareous, massive, pinkish-white substratum. The substratum varies from 36 inches to several feet in thickness and in many places contains numerous fragments of hard caliche.

This soil is adjacent to Clovis loam, 0 to 1 percent slopes, and Stegall loam, 0 to 1 percent slopes, and some small areas of these soils are included in the areas mapped.

Internal drainage is good, runoff is slow or moderate, and the movement of air and water through the subsoil is moderate. The water-holding capacity is good, and the moisture stored is readily available for plant use. If cultivated, this soil is slightly susceptible to wind erosion.

If irrigated, this soil is productive of peanuts, cotton, vegetables, and grain. As dry cropland, it is especially well suited to wheat. However, in climatic zone 4, which is the lower rainfall area of the county, or during years of countywide subnormal moisture, this soil is best suited to grain or forage sorghum. Blue grama and buffalograss are the dominant range grasses. *Dryland capability unit IIIce-1 if in climatic zone 3, and unit IVce-1 if in climatic zone 4; irrigated capability unit IIe-1; Loamy Upland range site.*

Amarillo loam, 1 to 3 percent slopes (Ae).—This is a deep soil that occurs in smooth, gently sloping areas throughout the county.

The surface layer is noncalcareous, friable, granular, reddish-brown loam that is about 10 inches thick. The subsoil is noncalcareous, reddish-brown sandy clay loam about 30 to 40 inches thick. It has moderate to strong, prismatic structure and grades gradually to the substratum of pinkish-white, soft caliche. The substratum contains many fragments of hard caliche and is strongly calcareous and massive.

This soil is associated with Clovis loam, 1 to 3 percent slopes, which is moderately deep; with Mansker loam, 1 to 3 percent slopes, which is calcareous; and with Portales loam, 1 to 3 percent slopes. Small areas of these soils are included in the areas mapped.

Internal drainage is good, runoff is moderate or rapid, and permeability is moderate. The water-holding capacity is high, and the moisture stored in the soil is readily available for plant use. Wind erosion is a slight hazard on this soil, and water erosion is a slight or moderate hazard.

If this soil is properly irrigated, it is well suited to peanuts, cotton, small grain, and vegetables. Alfalfa and sorghum are also well suited. In climatic zone 3, which is the area of higher rainfall in the county, wheat grows well in years of average rainfall. If seasonal moisture is below normal, grain sorghum should be grown. In climatic zone 4, grain sorghum is suitable. Blue grama and buffalograss are the dominant grasses on the range. *Dryland capability unit IIIce-1 if in climatic zone 3, and unit IVce-1 if in climatic zone 4; irrigated capability unit IIIe-3; Loamy Upland range site.*

Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded (Af).—These soils represent areas that have been farmed and severely damaged by wind. The surface

is rough, undulating, and dunelike. In scattered areas, the caliche substratum is exposed.

The Amarillo soil makes up about 40 percent of this mapping unit. It has a reddish-brown surface layer that ranges from 4 to 24 inches in thickness. This layer is loose, structureless, and contains little organic matter. The subsoil is prismatic sandy clay loam and is about 40 inches thick. It is noncalcareous in the uppermost 30 inches and strongly calcareous in the lower part. The underlying substratum is strongly calcareous.

The Clovis soil makes up about 60 percent of this mapping unit. It has a reddish-brown surface layer that ranges from 4 to 18 inches in thickness. This layer is loose, structureless, and very low in organic-matter content. The subsoil is prismatic sandy clay loam and is about 10 to 20 inches thick. It is noncalcareous in the uppermost part but is more strongly calcareous with depth. It is underlain by the strongly calcareous, pink substratum.

Scattered areas of Amarillo loamy fine sand, 0 to 3 percent slopes, and Clovis loamy fine sand, 0 to 3 percent slopes, are included in the areas mapped.

Drainage is good, and runoff is slow. If revegetated, these severely eroded soils are fairly productive of mid and tall grasses. However, complete stabilization is difficult. *Dryland capability unit VIe–1, climatic zones 3 and 4; irrigated capability unit IVe–8; Sandy Upland range site.*

Arch loamy fine sand (0 to 1 percent slopes) (Ag).—This is a shallow, calcareous soil. It occurs mainly on the margin of the sandhills, along the northern and northeastern boundary of the Portales Valley. It also occurs in the southern part of the county, where it is associated with the Tivoli and Brownfield soils.

This soil has a coarse-textured, pale-brown surface layer, which is about 8 inches thick, and a medium-textured subsoil, which is about 6 to 10 inches thick. The subsoil is underlain abruptly by a layer of prominent, white, chalky, soft caliche.

Small areas of Tivoli fine sand and Gomez loamy fine sand are included in the areas mapped.

The Arch soil has slow runoff but good internal drainage. It is susceptible to damage by wind. The caliche layer limits the depth of the root zone.

This soil is not suitable for dryfarming. If irrigated, it is suited to alfalfa, grain sorghum, and mixtures of pasture plants. The range will support fair stands of mid and tall grasses. *Dryland capability unit VIe–3, climatic zones 3 and 4; irrigated capability unit IVe–11; Sandy Plains range site.*

Arch fine sandy loam (0 to 1 percent slopes) (Ah).—This is a grayish-brown, shallow, calcareous soil (fig. 5). It occurs mainly on smooth slopes in the Portales irrigated area but is also adjacent to many of the playas in other parts of the county.

The surface layer, which is 6 to 8 inches thick, is granular in structure and grades to a pale-brown subsoil. The subsoil is weakly prismatic light loam that is about 8 to 10 inches thick. The underlying substratum, which begins at a depth of about 14 inches, is limy, light-gray to white, soft caliche.

This soil is associated with the deeper Portales fine sandy loam, 0 to 1 percent slopes, and small areas of this deeper soil were included in mapping. These areas appear as dark spots within areas of this soil.

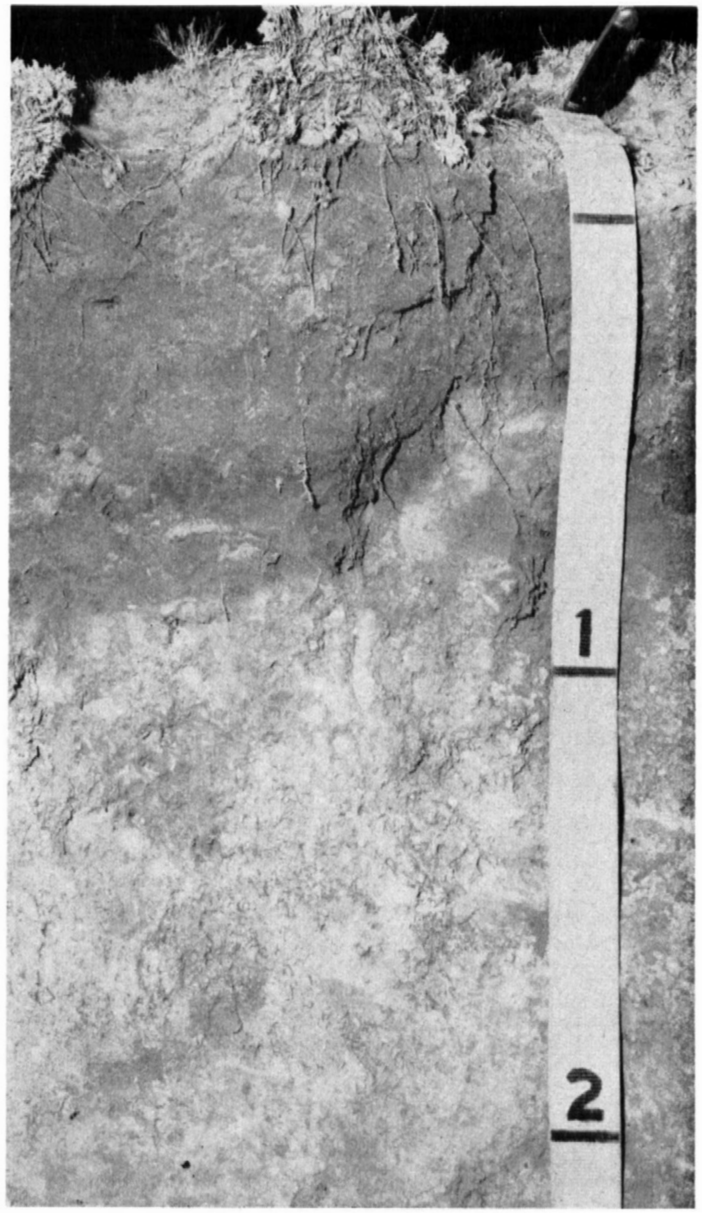

***Figure 5.*—Profile of Arch fine sandy loam (0 to 1 percent slopes). Few roots occur below a depth of 14 inches in the limy substratum.**

This Arch soil has good internal drainage and slow runoff. Air and water enter the subsoil at a moderate rate. Wind erosion is a serious hazard.

Under irrigation, suitable crops are alfalfa, sudangrass for pasture, and mixtures of pasture plants. Some small grain and sorghum can also be grown. Dryfarmed crops are not suitable. The range is suited to sideoats grama, blue grama, hairy grama, and little bluestem. *Dryland capability unit VIe–2, climatic zones 3 and 4; irrigated capability unit IVe–9; Limy Upland range site.*

Arch loam (0 to 1 percent slopes) (Ak).—This soil is shallow and calcareous. It occurs in nearly level areas along the margin of drainageways. In the Portales irrigated area, it overlies alluvial sediments of soft caliche.

The surface layer is light brownish-gray or pale-brown loam and is about 6 inches thick. It has weak granular

structure in the upper part and very weak prismatic structure in the lower part. The surface layer is underlain clearly or abruptly by a prominent layer of chalky caliche, which is moderately fine textured, massive, and more than 20 inches thick.

This soil is associated with the deeper Portales loam, 0 to 1 percent slopes, and the finer-textured Church clay loam. Small areas of these associated soils are included in the areas mapped.

Arch loam has good internal drainage and slow runoff. The movement of air and water through the subsoil is moderate. Wind erosion is a hazard because the soil aggregates are weak and are easily broken.

This soil is not suited to dryfarmed crops, but if irrigation water is available, it is suited to alfalfa, small grain, sorghum, and pasture plants. The dominant grasses on the range are sideoats grama, blue grama, and alkali sacaton. *Dryland capability unit VIe–2, climatic zones 3 and 4; irrigated capability unit IVe–9; Limy Upland range site.*

Arch soils, severely eroded (0 to 1 percent slopes) (Am).—This mapping unit occurs throughout the county but is most extensive in the area known as Blackwater Draw, which is north and northeast of Portales. Another area occurs in the vicinity of Milnesand.

The surface is rough and hummocky. Small dunes, 3 to 6 feet in height, are scattered throughout the eroded areas, and sand commonly accumulates along fence rows that border east-northeast field boundaries. In some areas, between the dunes, the white, chalky, soft caliche is exposed. Much of the original sandy surface layer has been sifted and reworked by the wind, and in many places the surface layer and subsoil are mixed to the extent that they cannot be identified.

Some small areas of Gomez loamy fine sand are included in the areas mapped.

Because of the damage caused by erosion, this mapping unit is very low in fertility. It is suited only to grass but is difficult to reseed because of the rough, hummocky surface. *Dryland capability unit VIe–2, climatic zones 3 and 4; Limy Upland range site.*

Arvana loamy fine sand, 0 to 3 percent slopes (An).—This soil is extensive throughout the county.

The surface layer consists of about 10 inches of reddish-brown loamy fine sand, and it has weak granular structure. The subsoil is about 16 inches of reddish-brown sandy clay loam, and it has coarse prismatic structure. At a depth of about 26 inches, there is a layer of hard, rocklike caliche that varies in thickness and is relatively impervious to both roots and water.

Included in the areas mapped are small areas of Clovis loamy fine sand, 0 to 3 percent slopes, and of Arvana loamy fine sand, shallow, 0 to 1 percent slopes.

In areas that are used for range, runoff is slight, but in cultivated fields that have a gradient of 1 to 3 percent, runoff is rapid and is likely to cause erosion. This soil has little resistance to wind erosion because of its sandy surface layer. Thus, crops that produce large amounts of residue are needed in cultivated fields, and grazing needs to be restricted on the range. Internal drainage is fair, permeability is moderate, and the water-holding capacity is low or moderate.

Deep breaking of this soil for the construction of silos and pit tanks or for the laying of pipelines may be difficult because of the layer of hard caliche that occurs at a moderate depth.

If irrigated, this soil can be used for grain sorghum, alfalfa, small grain, and pasture plants. If dryfarmed, it is suited to grain, forage sorghum, and broomcorn. *Dryland capability unit IVe–4 if in climatic zone 3, and unit VIe–1 if in climatic zone 4; irrigated capability unit IVe–6; Sandy Upland range site.*

Arvana loamy fine sand, shallow, 0 to 1 percent slopes (Ao).—This is a shallow, sandy soil that occurs in the Portales irrigated area. It is limited in extent.

Both the surface layer and subsoil are leached of lime and are reddish brown. The surface layer of loamy fine sand is about 6 inches thick. The subsoil has prismatic blocky structure and is only about 8 inches thick. It is underlain abruptly by a layer of hard, rocklike caliche that varies in thickness.

This soil is associated with the sandy Arvana and Potter soils. Small areas of Arvana loamy fine sand, 0 to 3 percent slopes, are included in the areas mapped.

Runoff is slow, and internal drainage is restricted by the layer of rocklike caliche. This hard layer also limits the depth of the root zone. Wind erosion is a serious hazard. Because of these limitations, this soil is not suitable for farming. *Dryland capability unit VIe–1, climatic zones 3 and 4; Sandy Upland range site.*

Arvana fine sandy loam, 0 to 1 percent slopes (Ap).—This soil is moderately deep. It occurs on smooth, nearly level uplands throughout the county.

Both the surface layer and subsoil are brown to reddish brown. The surface layer has weak granular structure and is about 8 inches thick. The subsoil is prismatic sandy clay loam and is 18 to 20 inches thick. It is underlain by a layer of hard caliche.

Small areas of Clovis fine sandy loam, 0 to 1 percent slopes, and of Kimbrough fine sandy loam are included in the areas mapped.

Water enters this soil readily, and internal drainage and the water-holding capacity are moderate. The penetration of roots and the movement of water are restricted at a moderate depth by the layer of hard caliche. Wind erosion is a moderate hazard.

The principal dryfarmed crops are grain, forage sorghum, and broomcorn. Wheat is grown occasionally. Suitable irrigated crops are peanuts, sweetpotatoes, cotton, and alfalfa. The range is productive of both mid and short grasses. *Dryland capability unit IIIe–2 if in climatic zone 3, and unit IVe–6 if in climatic zone 4; irrigated capability unit IIe–9; Sandy Upland range site.*

Arvana fine sandy loam, 1 to 3 percent slopes (Ar).—This soil occurs on smooth uplands throughout the county.

Both the surface layer and subsoil are brown to reddish brown. The surface layer is 6 to 8 inches thick, and it has weak granular structure. The subsoil is 16 to 20 inches of sandy clay loam, and it has coarse prismatic structure. It is underlain by a layer of hard caliche that varies in thickness.

This soil is associated with Arvana fine sandy loam, 0 to 1 percent slopes. Small areas of Clovis fine sandy loam, 1 to 3 percent slopes, and of Amarillo fine sandy loam, 1 to 3 percent slopes, are included in the areas mapped.

Runoff is moderate on this soil, and internal drainage is restricted at a moderate depth by the layer of hard

caliche. Wind erosion and water erosion are moderate hazards.

If dryfarmed, this soil is used principally for sorghum and broomcorn. Some slopes are terraced or farmed on the contour, or both. If management is good, the range supports fair to good stands of mid and short grasses. *Dryland capability unit IIIe-2 if in climatic zone 3, and unit IVe-6 if in climatic zone 4; irrigated capability unit IIIe-7; Sandy Upland range site.*

Arvana fine sandy loam, shallow, 0 to 1 percent slopes (As).—This soil occurs in the Portales irrigated area.

The surface layer is brown, noncalcareous fine sandy loam. It is about 4 to 8 inches thick and has fine granular structure. The subsoil is noncalcareous, brown to reddish-brown clay loam. It has medium prismatic structure to fine, subangular, blocky structure. A layer of hard caliche occurs at a depth of about 14 inches.

Some small areas of Arvana fine sandy loam, 0 to 1 percent slopes, are included in the areas mapped.

Runoff on this soil is moderate, the rate of water intake is high, and the water-holding capacity is low. Moisture is readily released for plant use. The subsoil is moderately permeable, but the layer of hard caliche restricts internal drainage. Wind erosion is a moderate hazard.

This soil requires light but frequent irrigation because of its low water-holding capacity and shallowness to hard caliche. Suitable crops under irrigation are peanuts, sweetpotatoes, small grain, alfalfa, and pasture plants. *Dryland capability unit VIe-1, climatic zone 3; irrigated capability unit IVe-13; Sandy Upland range site.*

Arvana soils, 0 to 3 percent slopes, severely eroded (Av).—These severely eroded soils consist mainly of previously cultivated fields in the dryfarmed area of the county and of a very limited acreage in the irrigated area.

Most of the original 8- to 10-inch surface layer has been removed by wind erosion, and the present surface layer is only about 2 to 5 inches thick. The subsoil of sandy clay loam is within plow depth. In places the substratum of hard caliche is near the surface, or it is exposed.

Included in the areas mapped are some small areas of Arvana fine sandy loam, shallow, 0 to 1 percent slopes, and of Kimbrough fine sandy loam.

These soils are hummocky because of the damage done by wind. They are so severely eroded and so shallow that they are not suitable for cultivation. Their best use is native grasses, which can be reseeded in drilled sudangrass or sorghum stubble. *Dryland capability unit VIIs-1, climatic zones 3 and 4; Shallow Upland range site.*

Berthoud sandy loam, 2 to 9 percent slopes (Ba).—This soil occurs in the western part of the county and to some extent in the panhandle.

The surface layer is about 8 inches of brown sandy loam. It has weak granular structure and contains many small or medium-sized pebbles. The subsoil is light-brown loam and is about 10 inches thick. This layer contains many roots and many medium-sized pebbles that are coated with caliche. Both the surface layer and the subsoil are strongly calcareous. The underlying substratum is strongly calcareous, structureless, pink fine sandy loam.

Some small areas of Mansker fine sandy loam, 1 to 3 percent slopes, are included in the areas mapped.

Runoff from this soil is moderate, and internal drainage generally is good. Wind erosion is slight or moderate because the caliche gravel on the surface helps to protect this soil.

Little, if any, of this soil is cultivated. The range supports stands of short and mid grasses. *Dryland capability unit VIe-1, climatic zones 3 and 4; Sandy Upland range site.*

Bippus and Spur soils (0 to 3 percent slopes) (Bb).—These are deep, moderately dark colored soils that occur on bottoms along drainageways throughout the county.

The surface layer of the Bippus soil is dark grayish-brown or brown, granular light clay loam (fig. 6). This layer is 6 to 8 inches thick and is leached of lime. The

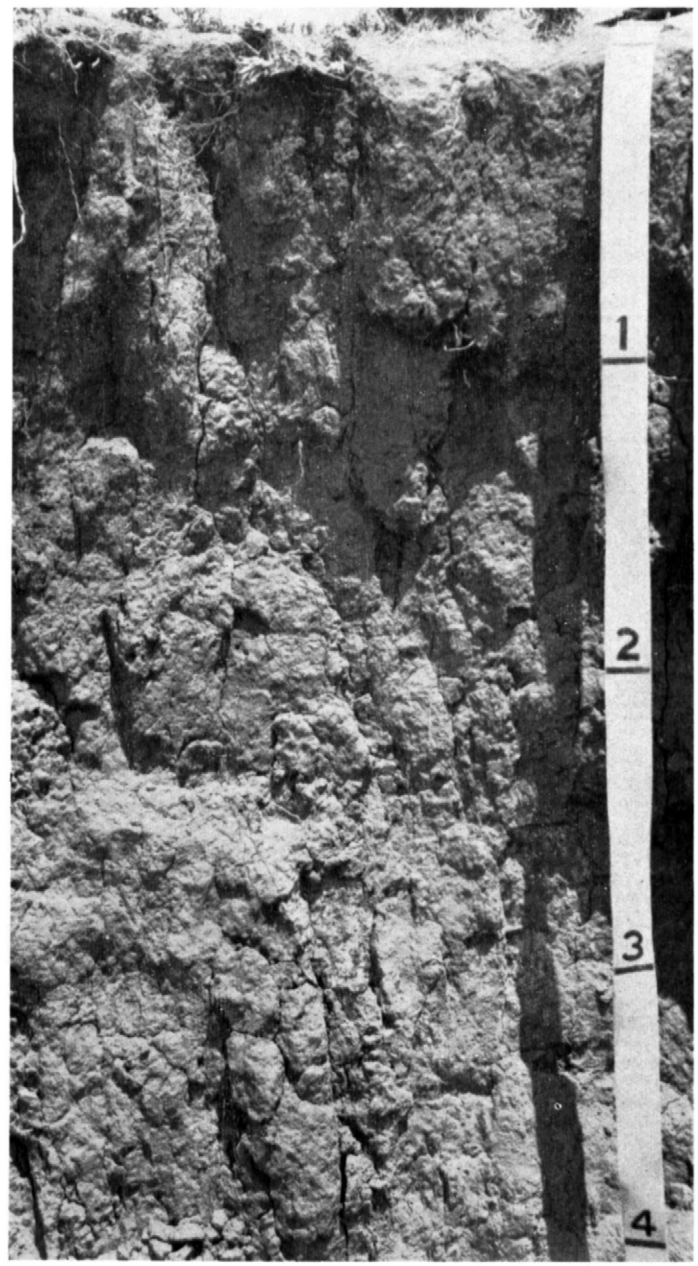

***Figure 6.*—Profile of Bippus clay loam.**

subsoil is about 6 inches of clay loam. It has subangular blocky structure and is moderately calcareous. The substratum is strongly calcareous, lime-enriched clay loam and is about 30 inches thick. In places layers of stratified sandy sediments occur below a depth of 3 to 5 feet.

The Spur soil has a brown, calcareous, granular surface layer that is about 8 inches thick. The subsoil is calcareous, brown clay loam and in places contains thin layers of sandy sediments. It ranges between 6 and 16 inches in thickness and has weak subangular blocky structure or prismatic structure. The substratum is strongly calcareous, massive sandy clay loam. In places it is stratified with coarse sand and gravel.

Small areas of Mansker, Portales, and Berthoud soils are included in some of the areas mapped. The included soils commonly occur along the outside boundary of drainageways, on slopes to higher lying areas.

Runoff is rapid but is confined to the drainage system. Internal drainage is good. Where these soils have been compacted either by machinery or by the trampling of cattle, water remains on the surface for some time. Wind erosion is not a serious hazard, but some gullies have formed. Bank sloughing occurs where stream channeling is active.

These soils are subject to overflow and consequently are of limited use for crops. Floodwater, however, benefits range plants. Short and mid grasses are dominant on the range. *Dryland capability unit VIw-3, climatic zones 3 and 4; Loamy Bottomland range site.*

Blackwater loam (0 to 1 percent slopes) (Bc).—This soil is of limited extent in the county and occurs only within the Portales irrigated area.

The surface layer is grayish-brown loam or sandy clay loam and is about 4 to 6 inches thick. It has medium subangular blocky structure that breaks to moderate granular structure. In places it grades to a light-gray clayey layer that is about 4 inches thick. If not destroyed by tillage, this clayey layer has weak, thin, platy structure and overlies a slowly permeable subsoil of blocky clay. The subsoil is about 13 inches thick and is underlain at a depth of about 22 inches by a layer of dense, durable, hard caliche. The caliche restricts the penetration of roots and retards the movement of water. The soil above the caliche layer has been leached of lime.

Except for a few small inclusions of Stegall loam, shallow, 0 to 1 percent slopes, the areas mapped consist wholly of Blackwater loam.

This soil occurs in slightly concave areas and has no well defined outlets. Consequently, runoff generally remains within the area. The water intake rate is slow, and internal drainage is moderate or slow. This soil has the capacity to hold about 3 inches of moisture that is slowly available to plants. Wind erosion is not a hazard.

The individual areas of this soil are smaller than field size. Consequently, it is difficult to select suitable crops for these areas. Alfalfa generally does not grow well because the soil is slowly permeable. Cotton, grain sorghum, and small grain are suitable if the soil is irrigated. *Dryland capability unit IIIce-2, climatic zone 3; irrigated capability unit IIe-5; Loamy Upland range site.*

Blown-out and dune land (5 to 20 percent slopes) (Bd).—This miscellaneous land type is made up of very severely wind eroded areas that are barren of vegetation. The organic matter and fine sediments of the original surface layer have been completely removed by erosion, and large, actively blowing sand dunes, 10 to 15 feet in height, are scattered throughout the areas. Interspersed between the dunes are blowouts where the subsoil is exposed. In some places the substratum is exposed.

Blown-out and dune land is common in the sandhills in the northern part of the county. It also occurs in the southern part, where it is associated with the sandy Amarillo and Brownfield soils. Here, the dunes are red to reddish brown, and the blowouts are spots where the surface layer of either the Amarillo or the Brownfield soil has been removed and the sandy clay loam subsoil is exposed. In areas where Blown-out and dune land is associated with the Tivoli soils, white caliche is exposed between the dunes. In these areas, some saltcedar is growing on the windward side, near the base of the dunes.

Most of the eroded areas in the southern part of the county resulted from attempts to farm very sandy land (fig. 7). To the lee side of these blown-out areas, large

Figure 7.—**Abandoned field showing blown-out land.**

dunes are encroaching on native grassland. In an effort to effect natural stabilization, this eroded land is fenced to exclude all livestock. Attempts to revegetate these areas by reseeding them to grass generally have not been successful. However, sandreed, sand bluestem, and Indiangrass are growing in the wetter areas on the windward side near the base of the dunes.

This land has little agricultural value. One area northeast of Portales is a State park, which is used as a picnic area and tourist attraction. *Dryland capability unit VIIe-1, climatic zones 3 and 4; Deep Sand range site.*

Brownfield fine sand (0 to 3 percent slopes) (Be).—This soil is extensive in the shin-oak section of the county, south of Milnesand, where it is closely associated with Amarillo loamy fine sand, 0 to 3 percent slopes.

The surface layer is about 18 to 23 inches thick and ranges from fine sand to loamy fine sand in texture and from brown to reddish brown in color. The uppermost 2 or 3 inches commonly has weak platy structure that is easily destroyed. The surface layer rests abruptly on the sandy clay loam subsoil. The subsoil ranges from 3 to 5 feet in thickness. It grades gradually from prismatic structure in the upper part to massive in the lower part and also is redder with depth. It is underlain by a red-

dish-yellow, strongly calcareous substratum of undetermined thickness.

Included in the areas mapped are some small areas of Amarillo loamy fine sand, 0 to 3 percent slopes; of Arvana loamy fine sand, 0 to 3 percent slopes; and of Gomez loamy fine sand. The Tivoli soils are associated with the Brownfield soil but generally are not included in the areas mapped.

Runoff on the Brownfield soil is slight, and internal drainage is good, but the hazard of wind erosion is severe. This soil is not suitable for farming. *Dryland capability unit VIe-3, climatic zones 3 and 4; Sandy Plains range site.*

Brownfield soils, severely eroded (Bf).—These severely eroded soils are old fields that are being cultivated or that have been abandoned. They make up nearly 40,000 acres in the southern part of the county.

About 50 to 75 percent of the original surface layer has been removed by erosion, and where sand has not accumulated, tillage operations have mixed some of the sandy clay loam subsoil into the present surface layer.

These eroded soils contain little organic matter and are low in fertility. They are not capable of producing the cover needed to prevent their being further damaged by wind. If not stabilized, however, they are likely to develop into duned areas similar to those described as Blownout and dune land. *Dryland capability unit VIIe-1, climatic zones 3 and 4; Deep Sand range site.*

Church clay loam (0 to 1 percent slopes) (Co).—This soil occurs principally on first terraces of the large playas and to a minor extent on bottoms along large drainageways.

The surface layer is about 6 to 8 inches of dark grayish-brown, strongly calcareous clay loam. It is underlain abruptly by a light brownish-gray, clay subsoil. The subsoil is several feet thick and is strongly mottled in the lower part, an indication of the wet condition under which this soil developed. The parent material is chalky lacustrine sediment that ranges from light gray to olive yellow in color. In many places the substratum is stratified with lenses of sand. The entire profile is calcareous. Small areas of Arch loam are included in the areas mapped.

Where the Church soil occurs in the channels of drainageways, runoff is rapid. On the playa bottoms, internal drainage is slow and runoff is confined. Consequently, in these areas the soil is flooded intermittently.

This soil supports relatively thick stands of such alkali-tolerant grasses as sacaton and tobosa. Cotton and alfalfa are suitable crops under irrigation, but little of the acreage is farmed. *Dryland capability unit VIw-2, climatic zones 3 and 4; irrigated capability unit IIIe-11; Salt Flats range site.*

Church soils, severely eroded (0 to 1 percent slopes) (Cb).—These soils occur only in the Portales irrigated area. They are limited in extent.

All but a few inches of the original surface layer has been removed by erosion. The remaining surface soil is light gray in color and crusted. Wind erosion has caused the formation of many small but widely scattered silt dunes.

Air and water move slowly through the surface layer and subsoil. The substratum is permanently moist below a depth of 3 feet, but few, if any, roots extend to this depth. Attempts to use these soils for irrigated crops have been unsuccessful. *Dryland capability unit VIw-2, climatic zones 3 and 4; Salt Flats range site.*

Clovis loamy fine sand, 0 to 3 percent slopes (Cc).—This sandy soil is extensive south of Portales.

Both the surface layer and subsoil are reddish brown and noncalcareous. The surface layer is about 8 inches thick, and it has weak, coarse, granular structure. The subsoil, which is about 20 inches thick, is sandy clay loam that has weak to moderate prismatic structure. The substratum is strongly calcareous and in most places is clay loam. In irrigated areas, the substratum is permanently moist, but this high-lime layer restricts the growth of roots.

Included in the areas mapped are small areas of Amarillo loamy fine sand, 0 to 3 percent slopes, and of Arvana loamy fine sand, 0 to 3 percent slopes.

On the stronger slopes, especially in cultivated fields, runoff may be rapid following heavy rains of short duration. In other areas, runoff is slight. Internal drainage is good, permeability is moderate, the rate of water intake is rapid, and the water-holding capacity is moderate. Stored moisture is readily available for plant use. This soil is less resistant to wind erosion than the medium-textured and moderately coarse textured Clovis soils.

Crops suitable for dryfarming are sudangrass, broomcorn, and sorghum. Under irrigation, the most suitable crops are sweetpotatoes, alfalfa, and pasture plants. The range supports good stands of mid and tall grasses. *Dryland capability unit IVe-4 if in climatic zone 3, and unit VIe-1 if in climatic zone 4; irrigated capability unit IVe-6; Sandy Upland range site.*

Clovis fine sandy loam, 0 to 1 percent slopes (Cd).—This soil is moderately deep. It is extensive throughout the county but is most extensive in the west-central part.

The surface layer is about 6 to 8 inches of granular fine sandy loam. This layer is slightly redder than the surface layer of the medium-textured Clovis soils and also is less resistant to wind erosion. The subsoil is reddish-brown sandy clay loam. It is about 24 inches thick and has weak prismatic structure. It is underlain at a depth of about 30 inches by a strongly calcareous layer that varies in thickness and ranges from loam to clay loam (fig. 8). This underlying layer contains few roots and has little or no structure.

Included in the areas mapped are small areas of Amarillo fine sandy loam, 0 to 1 percent slopes, which is deeper than the Clovis soil.

Runoff is slight, internal drainage is good, and permeability is moderate. Under irrigation, this soil takes water readily, and it is capable of holding a moderate amount of water that plants can use. Wind erosion is a moderate hazard because of the sandy surface layer. The strongly calcareous layer that underlies the subsoil restricts the growth of plant roots.

Grain sorghum is the principal crop if this soil is dryfarmed, but wheat is grown occasionally. Peanuts, sweetpotatoes, and cotton are suitable cash crops if this soil is irrigated. The range supports stands of mid and short grasses. *Dryland capability unit IIIe-2 if in climatic zone 3, and unit IVe-6 if in climatic zone 4; irrigated capability unit IIe-9; Sandy Upland range site.*

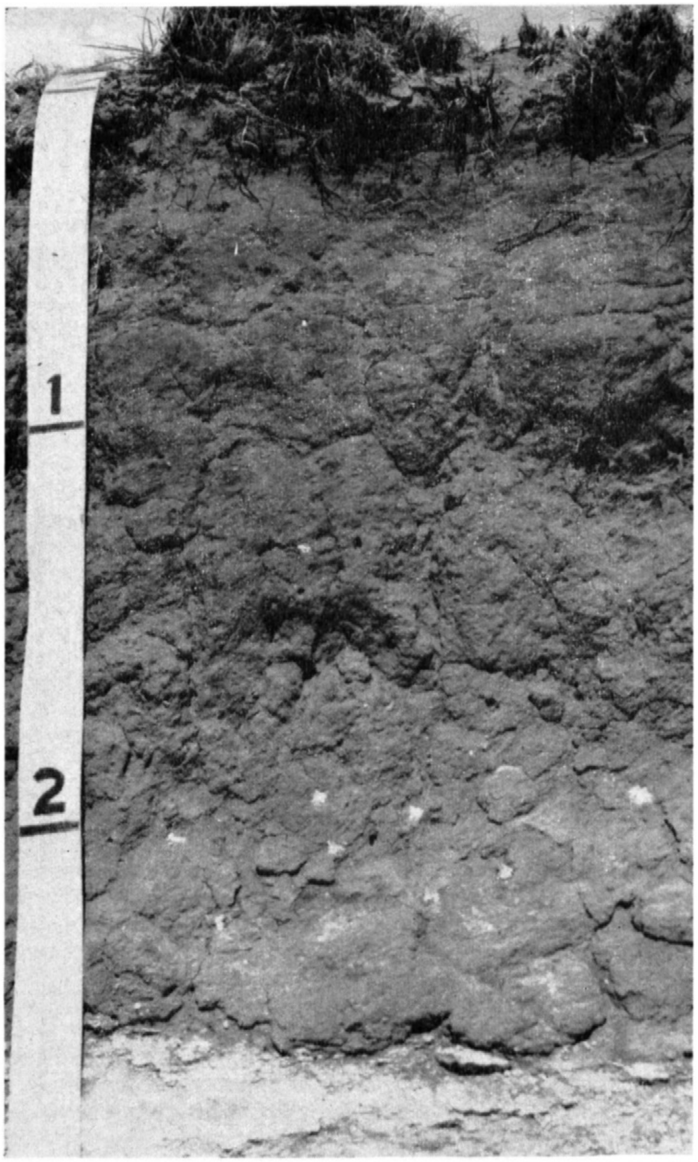

Figure 8.—**Profile of Clovis fine sandy loam, 0 to 1 percent slopes, showing zone of calcium carbonate at depth of about 2½ feet.**

Clovis fine sandy loam, 1 to 3 percent slopes (Ce).—This soil is closely associated with Clovis fine sandy loam, 0 to 1 percent slopes, but is much less extensive.

Both the surface layer and subsoil are reddish brown. The surface layer is about 8 inches thick, and it has weak granular structure. The subsoil is about 20 inches of sandy clay loam, and it has weak to moderate prismatic structure. It is underlain by a strongly calcareous, yellowish-red substratum. In some places there are a few fragments of caliche in the substratum, and in other places there are many.

Included in the areas mapped are small areas of Amarillo fine sandy loam, 1 to 3 percent slopes, which is deeper than the Clovis soil.

Runoff is moderate, and internal drainage is good. The rate of water intake is moderate or rapid if this soil is irrigated, and the moisture-holding capacity is moderate or high.

This soil is moderately susceptible to wind and water erosion. The caliche layer, which occurs at a moderate depth, limits the depth to which cuts can be made in land leveling and restricts the depth of the root zone.

Grain sorghum is the principal dryfarmed crop. Peanuts, sweetpotatoes, cotton, and alfalfa are suitable crops under irrigation. Mid and short grasses are dominant on the range. *Dryland capability unit IIIe-2 if in climatic zone 3, and unit IVe-6 if in climatic zone 4; irrigated capability unit IIIe-7; Sandy Upland range site.*

Clovis loam, 0 to 1 percent slopes (Cf).—Much of this soil occurs in the wheatland area in the vicinity of Rogers and Dora, and a considerable acreage is west of Floyd.

The surface layer is brown and is about 6 inches thick. It has weak subangular blocky structure that breaks to weak granular structure. The subsoil is reddish brown and ranges from 16 to 24 inches in thickness. It has weak prismatic structure. Both the surface layer and upper part of the subsoil are noncalcareous. The reddish-yellow substratum begins at a depth of about 30 inches and varies in thickness. This layer contains few roots and is strongly calcareous.

Included in the areas mapped are small areas of the moderately deep Stegall loam, 0 to 1 percent slopes, and of the more shallow Mansker and Portales loams, 1 to 3 percent slopes.

Runoff is slight or moderate on this soil, and internal drainage is good. The rate of water intake is moderate, permeability is moderate, and the water-holding capacity is good. The moisture stored is readily available for plant use.

This soil is only slightly susceptible to wind erosion. The layer of soft caliche, which occurs at a moderate depth, limits the depth to which cuts can be made in leveling for irrigation.

Wheat is the principal dryfarmed crop, except during years of subnormal moisture. In these years, grain sorghum is grown. Peanuts, cotton, sweetpotatoes, and alfalfa are grown under irrigation. If well managed, the range supports good or excellent stands of short and mid grasses. *Dryland capability unit IIIce-2 if in climatic zone 3, unit IVce-2 if in climatic zone 4; irrigated capability unit IIe-3; Loamy Upland range site.*

Clovis loam, 1 to 3 percent slopes (Cg).—This soil occurs throughout the county but is less extensive than the associated nearly level Clovis loam.

The surface layer is brown, granular loam and is about 6 inches thick. The subsoil is reddish-brown sandy clay loam. The uppermost 20 inches of this soil is noncalcareous. A strongly calcareous lime zone begins at a depth of about 24 inches and limits the depth of the effective root zone.

Included in the areas mapped are small areas of Mansker and Portales loams, 1 to 3 percent slopes.

This soil has good internal drainage, and it is moderately permeable. The rate of water intake is moderate, the water-holding capacity is good, and the moisture stored is readily available for plant use. Runoff is rapid, and the hazard of water erosion is slight or moderate, depending on the amount of protective vegetation. The hazard of wind erosion is slight because the soil aggregates of the surface layer are sufficiently stable to resist soil blowing.

Suitable dryfarmed crops are wheat and sorghum. Suitable irrigated crops are peanuts, sweetpotatoes, and alfalfa.

If well managed, the range supports good stands of mid and short grasses. *Dryland capability unit IIIce-2 if in climatic zone 3, and unit IVce-2 if in climatic zone 4; irrigated capability unit IIIe-6; Loamy Upland range site.*

Drake soils (1 to 5 percent slopes) (Dr).—These soils developed in wind-deposited material on the lee side of the numerous playas that dot the landscape throughout the county (fig. 9). In most places the slope ranges from 1 to 5 percent, but in a few places it is as much as 25 percent.

Horizonation in these soils is weak and indistinct. The surface layer is pale-brown loam or fine sandy loam. It has weak, fine, granular structure and is about 8 inches thick. This layer is strongly calcareous and grades to the very strongly calcareous, light-gray, massive substratum. The substratum is several feet thick and ranges from loam to silty clay loam.

Small areas of Mansker soils are included in some of the areas mapped, but most of the delineated areas are all Drake soils.

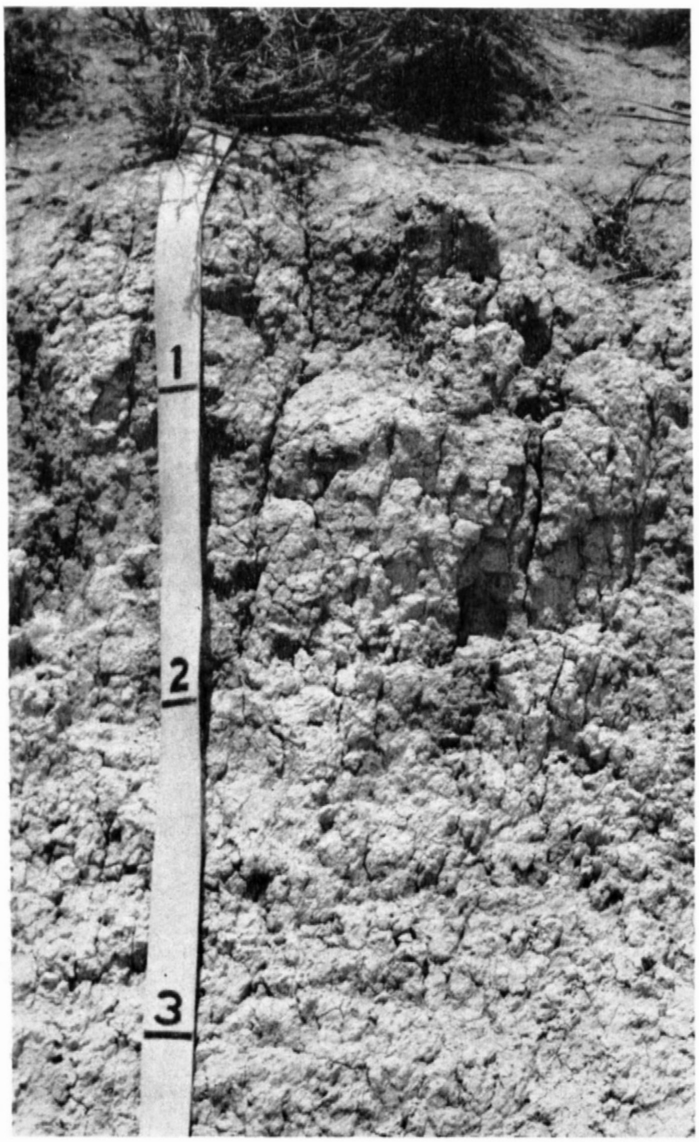

Figure 9.—**Profile of Drake loam. Drake soils occur on the lee side of playas.**

Runoff is rapid on these soils, and numerous gullies have formed on the steeper slopes. Internal drainage is good, but much of the moisture received is lost because of rapid runoff. If the grass cover is not overgrazed, wind erosion is slight.

These soils have been farmed only where they are needed to form a rectangular field. The range supports fair stands of mid and short grasses. *Dryland capability unit VIe-2, climatic zones 3 and 4; irrigated capability unit IVe-12; Limy Upland range site.*

Gomez loamy fine sand (0 to 3 percent slopes) (Go).—This is a moderately deep, level to gently sloping soil. It occurs mainly on the margins of valleys that have cut into the uplands on the High Plains. Small areas also occur adjacent to Tivoli fine sand in the Portales Valley, and a limited acreage occurs in the southern part of the county, where it is associated with the Brownfield soils.

This soil shows little if any structural development. The surface layer of loamy fine sand is noncalcareous and is about 12 inches thick. It ranges from grayish brown in the upper part to brown in the lower part. The underlying layer is strongly calcareous and has very weak subangular blocky structure. It is about 10 inches thick and is underlain abruptly by the gray, chalky, moist substratum, which varies in thickness (fig. 10).

Included in some of the areas mapped are small areas of Arch loamy fine sand, 0 to 1 percent slopes.

The Gomez soil has a high rate of water intake, is moderately permeable, and has low or moderate water-holding capacity. Runoff is slow, and internal drainage is good.

This soil is highly susceptible to wind erosion and is not suitable for dryfarming. If irrigated, it can be used for alfalfa, grain, and forage sorghum. The range supports fair to good stands of little bluestem and sideoats grama. *Dryland capability unit VIe-3, in climatic zones 3 and 4; irrigated capability unit IVe-11; Sandy Plains range site.*

Hilly gravelly land (0 to 15 percent slopes) (Hg).—This miscellaneous land type occurs mainly on gravelly ridges in the panhandle section of the county. It is not extensive.

The surface layer is gravelly, brown sandy loam. It has very weak granular structure and contains many coarse, waterworn, quartz pebbles. This layer is underlain at a depth of about 12 inches by a pale-brown, strongly calcareous, very gravelly layer. Many of the pebbles are coated with lime.

Included in the areas mapped are small areas of Berthoud sandy loam, 2 to 9 percent slopes, and of Potter soils, 0 to 9 percent slopes. The Berthoud soils are reddish brown and calcareous, and the Potter soils are pale brown and shallow.

Hilly gravelly land has moderate runoff and good internal drainage. It generally is not susceptible to serious damage by either wind or water erosion, because numerous pebbles in the surface layer help to stabilize the soil material.

This land is not suited to cultivated crops but supports fair to good stands of mid grasses. *Dryland capability unit VIIs-2, climatic zones 3 and 4; Gravelly Upland range site.*

Kimbrough fine sandy loam (0 to 3 percent slopes) (Ka).—This is a shallow soil. It is not extensive in the county.

The uppermost 2 to 4 inches of this soil is granular in structure and noncalcareous. The subsoil is sandy clay

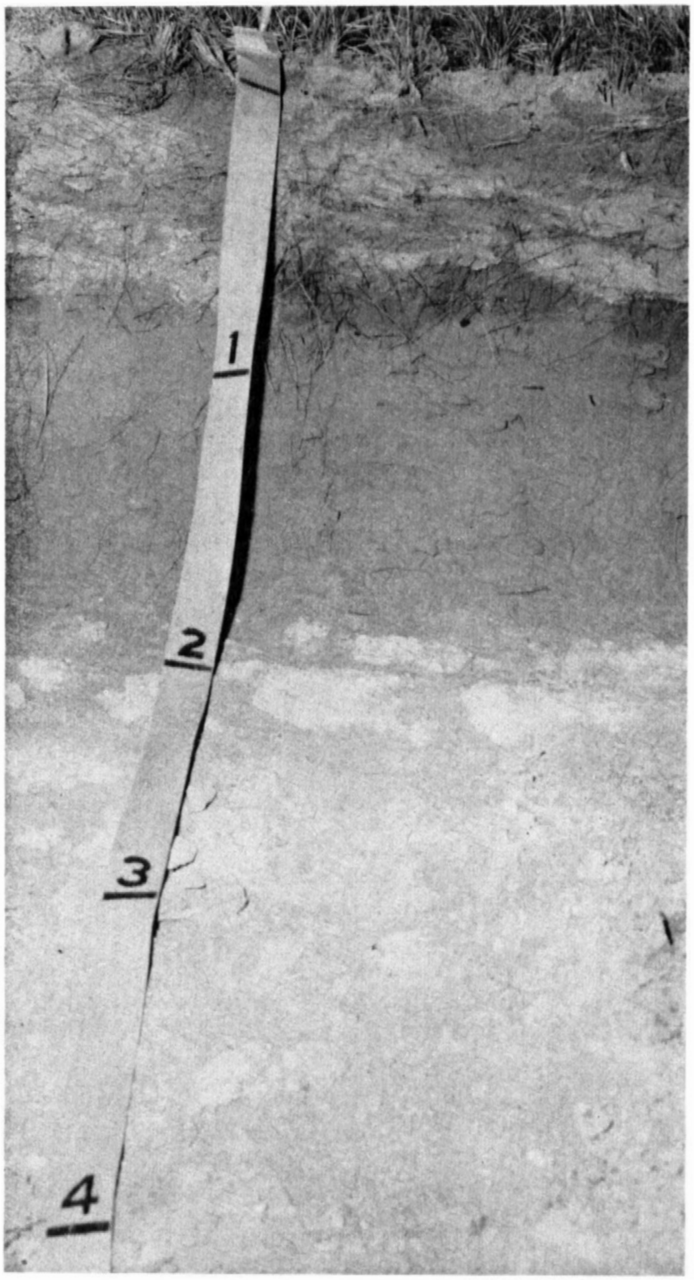

Figure 10.—**Profile of Gomez loamy fine sand.**

loam. It is subangular blocky in structure and is also noncalcareous. This layer is underlain abruptly at a depth of about 8 inches by a layer of hard caliche that varies in thickness.

This soil is associated with the Potter soils and with Arvana fine sandy loams, and small areas of these soils are included in the areas mapped.

The control of runoff is not a problem, but slight to moderate wind erosion can be expected. The layer of hard caliche limits the depth of the root zone and restricts internal drainage.

This shallow soil supports fair to good stands of mid and short grasses. *Dryland capability unit VIIs–1, climatic zones 3 and 4: Shallow Upland range site.*

Kimbrough loam (0 to 1 percent slopes) (Kb).—This is a shallow soil that occurs in small, widely scattered areas throughout the county.

The surface layer of dark grayish-brown loam ranges from 2 to 4 inches in thickness, is noncalcareous, and has moderate to strong granular structure. The subsoil has subangular blocky structure and ranges from 4 to 8 inches in thickness. This layer is noncalcareous in the upper part and slightly calcareous in the lower part. It is underlain abruptly by a layer of hard caliche that varies in thickness.

This soil is closely associated with the level or nearly level Stegall and Clovis soils, and small areas of these soils are included in the areas mapped.

Runoff is slow, except in wet weather when the soil becomes saturated. The resistance to wind erosion is good. Both root penetration and internal drainage are restricted by the layer of hard caliche.

The principal grasses on this soil are blue grama, black grama, hairy grama, sideoats grama, and little bluestem. *Dryland capability unit VIIs–1, climatic zones 3 and 4; Shallow Upland range site.*

Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Mc).—This undifferentiated mapping unit occurs on gently sloping uplands throughout the county. About 60 percent of the mapping unit is Mansker fine sandy loam.

The soils of this unit are similar in color, and both have a brown, moderately coarse textured, calcareous, granular surface layer that is about 5 inches thick. In both, the subsoil is calcareous, but it is more strongly calcareous in the Mansker soil. In the Mansker soil, the subsoil is 8 to 10 inches thick and massive. It overlies a yellowish-brown substratum that contains many medium-sized and large fragments of caliche. Fragments of caliche occur on the surface and throughout the soil material. In the Portales soil, the subsoil has weak prismatic structure and is about 12 inches thick. This layer overlies a prominent, chalky substratum. The Portales soil contains few, if any, caliche fragments.

Small areas of the more nearly level Potter soils and of Clovis fine sandy loam, 1 to 3 percent slopes, are included in the areas mapped.

The Mansker and Portales soils are well drained and are moderately susceptible to wind erosion. Both have a moderately permeable subsoil. Runoff is moderate.

Suitable dryfarmed crops are grain and forage sorghum. Suitable irrigated crops are small grain, alfalfa, and pasture plants. The range supports fair stands of mid and tall grasses. *Mansker fine sandy loam is in dryland capability unit IVe–3 if in climatic zone 3, and unit VIe–2 if in climatic zone 4; irrigated unit IVe–7; Limy Upland range site. Portales fine sandy loam is in IVe–3 if in climatic zone 3, and unit VIe–1 if in climatic zone 4; irrigated unit IIIe–7; Sandy Upland range site.*

Mansker and Portales loams, 1 to 3 percent slopes (Md).—This undifferentiated mapping unit occupies many of the gentle slopes throughout the county.

The soils of this unit have similar profile characteristics. Both have a 5-inch, brown to grayish-brown, calcareous surface layer that has weak granular structure. In both, the subsoil is sandy clay loam, but in the Mansker soil, this layer is massive, or structureless, and in the Portales it has weak to moderate prismatic structure. The Mansker soil is underlain at a depth of less than 20 inches by yellowish-

brown caliche, and there are many medium-sized and large fragments of caliche on the surface and throughout the soil material. The Portales soil is underlain at a depth of 20 to 36 inches by a soft, chalky, prominent lime zone.

Included in the areas mapped are small areas of Clovis loam, 1 to 3 percent slopes, and of Potter soils, 0 to 9 percent slopes.

The Mansker and Portales soils are well drained and are moderately permeable. Runoff is moderate or rapid. Wind erosion is slight, but water erosion is moderate, and there are some scattered gullies.

If dryfarmed, these soils are suited to grain and forage sorghum and can be used occasionally for wheat. Under irrigation, they are suited to vegetables, small grain, cotton, and alfalfa. The range supports fair to good stands of mid and short grasses. *Mansker loam is in dryland capability unit IVe–2 if in climatic zone 3, and unit VIe–2 if in climatic zone 4; irrigated unit IVe–7; Limy Upland range site. Portales loam is in dryland capability unit IVe–2 if in climatic zone 3, and unit IVce–2 if in climatic zone 4; irrigated unit IIIe–6; Loamy Upland range site.*

Montoya clay loam (0 to 3 percent slopes) (Me).—This is a reddish-brown soil that developed in fine-textured alluvium from areas of red-bed shale. It occurs southwest of Elida and in the vicinity of Red Lake, between Elida and Dora. It is limited in extent.

The surface layer consists of about 12 inches of calcareous, granular heavy clay loam. Roots are abundant in this layer. The subsoil is silty clay. It is about 18 inches thick, has weak, coarse, subangular blocky structure, and is strongly calcareous. It is underlain by reddish-brown, massive, strongly calcareous clay or silty clay that contains numerous fragments of weathered shale. This underlying layer generally is moist and mottled, an indication that the soil formed under wet conditions.

Included in the areas mapped are a few areas of Berthoud sandy loam, 2 to 9 percent slopes, and small areas of Travessilla loam.

Runoff is rapid on this soil, and internal drainage is slow. Soil piping is common. Some gullies have formed in areas where the vegetation has been destroyed by roads or cattle trails. It will be difficult to prevent further erosion of many of these gullies because runoff is rapid. When wet, this soil is unstable and very slick.

This soil is not farmed, but it provides fair grazing. Tobosa is the principal grass, but grama grasses and buffalograss occur in the plant cover. *Dryland capability unit VIw–1, climatic zones 3 and 4; Valley Clay range site.*

Olton loam, 0 to 1 percent slopes (Ot).—This soil occurs in the wheat-growing section of the county in the vicinity of Rogers and Dora. It is not extensive.

The surface layer consists of about 4 inches of brown to dark-brown loam. It has strong granular structure and is noncalcareous. The subsoil is noncalcareous clay loam. It is about 24 inches thick and has subangular blocky structure (fig. 11). This layer overlies a strongly calcareous layer that is 18 to 20 inches thick, light reddish brown in color, and massive. The substratum is very strongly calcareous pink silt loam. It is similar to the parent sediments of the Amarillo soils.

Included in the areas mapped are a few small areas of Amarillo loam, 0 to 1 percent slopes, and of Stegall loam, 0 to 1 percent slopes.

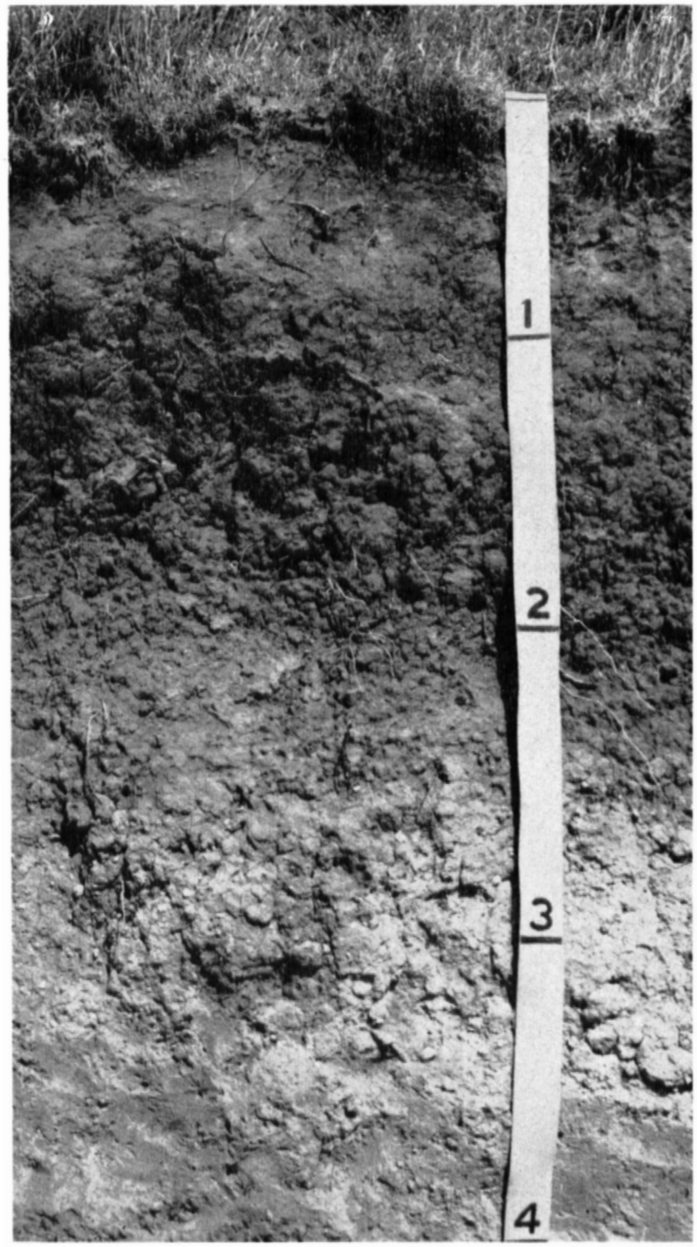

Figure 11.—**Profile of Olton loam, 0 to 1 percent slopes, showing subangular blocky structure of subsoil.**

Runoff is moderate, and internal drainage is slow. Puddling is common following a hard rain. Wind erosion is a slight or moderate hazard.

If dryfarmed, this soil is used principally for wheat, but it also produces good yields of grain sorghum. The range is productive of both short and mid grasses. *Dryland capability unit IIIce–1 if in climatic zone 3, and IVce–1 if in climatic zone 4; irrigated capability unit IIe–4; Loamy Upland range site.*

Olton-Zita loams, 0 to 1 percent slopes (Oz).—This complex consists of a limited acreage of wheat-producing soils in the panhandle section of the county.

The surface layer of both soils is about 4 to 6 inches of dark grayish-brown to brown heavy loam. This layer

has moderate, medium, granular structure. In the Olton soil, the clay loam subsoil is about 21 inches thick and has prismatic structure that breaks to moderate subangular blocky structure. It is underlain by a pink to reddish-yellow, strongly calcareous, massive substratum that contains fragments of caliche. In the Zita soil, the sandy clay loam subsoil is 15 inches thick and has moderate, medium, prismatic structure. It is underlain by white, chalky, soft caliche.

Included in the areas mapped are small areas of Amarillo loam, 0 to 1 percent slopes, and of Clovis loam, 0 to 1 percent slopes.

The soils of this complex have good internal drainage, a moderately permeable subsoil, and moderate runoff. Wind erosion is a slight or moderate hazard.

If moisture conditions are favorable at planting time, these soils are suited to wheat. In dry years, they can be summer fallowed or seeded to grain sorghum. The dominant vegetation on the range is mid and short grasses. *Olton loam is in dryland capability unit IIIce-1 if in climatic zone 3, and unit IVce-1 if in climatic zone 4; irrigated unit IIe-4; Loamy Upland range site. Zita loam is in dryland capability unit IIIce-2 if in climatic zone 3, and unit IVce-2 if in climatic zone 4; irrigated unit IIe-3; Loamy Upland range site.*

Portales fine sandy loam, 0 to 1 percent slopes (Pa).—This soil occurs mainly south and east of Portales, within the Portales irrigated area.

The surface layer is calcareous, grayish-brown fine sandy loam. It is about 6 inches thick and has fine granular structure. The subsoil is moderately permeable, calcareous loam. It is about 12 inches thick and has weak prismatic structure. The substratum is limy, massive, gray clay loam. Water moves into the substratum readily, but few roots occur in this layer.

Small areas of light-colored Arch fine sandy loam are included in the areas mapped.

The Portales soil takes water readily, and it holds a moderate amount of moisture that crops can use. Runoff is slow, and internal drainage is good. Wind erosion is a moderate hazard, and careful management is needed to minimize damage by wind.

This soil is suited to peanuts, cotton, sweetpotatoes, and alfalfa. The range supports good stands of mid grasses. *Dryland capability unit IVe-3 if in climatic zone 3, and VIe-1 if in climatic zone 4; irrigated capability unit IIe-9; Sandy Upland range site.*

Portales loam, 0 to 1 percent slopes (Pb).—This soil occurs mainly west and northwest of Portales in the vicinity of Bethel.

The surface layer, which is about 4 to 8 inches thick, has good tilth and fine granular structure. In places this layer is calcareous. The subsoil is calcareous, prismatic sandy clay loam about 15 inches thick. It is underlain by a lime zone that is light gray in color and ranges from sandy loam to clay loam. Few roots occur in this chalky substratum, but movement of moisture through this layer is moderate. Included in the areas mapped are small areas of Arch loam.

Control of runoff is not difficult on this soil, except following intense storms of short duration. Drainage through the soil is good. This soil takes water readily, and it is capable of holding a moderate amount of moisture that crops can use.

The principal crops under irrigation are peanuts, cotton, and sweetpotatoes. Grain sorghum is suitable if the soil is dryfarmed. Mid and short grasses are dominant on the range. *Dryland capability unit IVe-2 if in climatic zone 3, and IVce-2 if in climatic zone 4; irrigated capability unit IIe-3; Loamy Upland range site.*

Potter soils, 0 to 9 percent slopes (Pc).—These soils are extensive on the ridges and escarpments throughout the county, and they commonly occur on the windward slopes of playas.

These are soils that have a pale-brown, calcareous surface layer about 6 inches thick. This layer has very weak subangular blocky structure that breaks to weak granular structure. It grades to a strongly calcareous layer that contains many loose, medium-sized fragments of coarse caliche.

Small areas of Mansker loam, 1 to 3 percent slopes, are included in some of the areas mapped.

Runoff is moderate or rapid on these soils, but water erosion is not a serious hazard, because of the resistance of the imbedded caliche rock. Wind erosion is negligible. Internal drainage is good.

These soils are not suited to crops. They support fair stands of short and mid grasses, but in places there are heavy invasions of snakeweed. They are often used as base material in the construction of roads. *Dryland capability unit VIIs-1, climatic zones 3 and 4; Shallow Upland range site.*

Riverwash (Ra).—This land type occurs in the panhandle section of the county. It consists mainly of loose, medium-textured and coarse-textured sandy material and beds of gravel in unstable stream channels. There is no profile development. These areas are subject to occasional overflow and flooding.

This material has little agricultural value. It is used to some extent for construction purposes. In a few places, saltcedar and cottonwood trees grow on or near the creekbed. Riverwash is not shown in a range site, but it generally is included in the range site of adjacent areas. *Dryland capability unit VIIIw-1, climatic zones 3 and 4.*

Rough broken land (5 to 25 percent slopes) (Rb).—This land type is known locally as the Breaks and as the High Plains escarpments. The Breaks are the very steep, very shallow ridges that occur in rough, broken areas in the panhandle. The High Plains escarpments occur mainly in the vicinity of Elida and Kenna.

The surface layer of this land type is thin and ranges from sandy loam to loam. Many rocks of sandstone or caliche are exposed, and in some areas shale red beds are exposed near the base of steep breaks.

Wind erosion is negligible, but water erosion has caused the formation of many gullies. Runoff is rapid, and internal drainage is good.

These areas have limited use for grazing because their slopes are not readily accessible. However, these slopes offer some protection to cattle during inclement weather. Some areas provide good base material for road construction.

Black grama, sideoats grama, juniper, and yucca are the common vegetation. *Dryland capability unit VIIs-1, climatic zones 3 and 4; Shallow Upland range site.*

Springer loamy fine sand (0 to 5 percent slopes) (Sf).—This soil occurs throughout the county but is most extensive north of Portales and south of Causey.

Both the surface layer and subsoil are noncalcareous. The surface layer is reddish-brown loamy fine sand. It has very weak granular structure and is about 14 inches thick. The subsoil is yellowish-red fine sandy loam. This layer has weak prismatic structure and is 30 to 40 inches thick. It is underlain by the strongly calcareous, coarse-textured parent material.

Included in the areas mapped are small areas of Amarillo loamy fine sand, 0 to 3 percent slopes.

Runoff is slow, and internal drainage is good. The rate of water intake is high, permeability is rapid, and the water-holding capacity is low or moderate. The hazard of wind erosion is moderate or severe. Overgrazing of vegetation may result in the soil being severely damaged by wind.

This soil is productive of mid and tall grasses. Little of the acreage is irrigated. High-residue forage sorghums are suitable if water is available. *Dryland capability unit VIe–3, climatic zones 3 and 4; irrigated capability unit IVe–8; Sandy Plains range site.*

Springer soils, severely eroded (0 to 5 percent slopes) (Sp).—These soils are of moderate extent in the county. Most of the acreage is abandoned farmland.

These soils have been reworked by wind to the extent that the original surface layer of loamy fine sand is now loose fine sand, and there are many dunes and small sandy hummocks. The sand has drifted along fence rows to form dunes from 2 to 8 feet high. In some severely eroded spots, the yellowish-red sandy subsoil is exposed.

Small areas of Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded, are included in the areas mapped.

Runoff is slow, and internal drainage is good. Rainfall that occurs during intense storms of short duration soaks rapidly into these sandy soils.

These soils are highly susceptible to continued severe wind erosion. They can be revegetated to native grasses and, if well managed, will provide limited grazing. *Dryland capability unit VIe–3, climatic zones 3 and 4; Sandy Plains range site.*

Stegall loam, 0 to 1 percent slopes (St).—This is a moderately deep soil that is widely scattered throughout the county.

The surface layer of brown to dark-brown loam has weak granular structure and is about 6 to 8 inches thick. The subsoil of brown to reddish-brown heavy sandy clay loam has moderate to strong prismatic structure and is about 12 to 24 inches thick. The underlying substratum is hard caliche that varies in thickness, is very durable, and is impervious to roots.

Small areas of Amarillo loam, 0 to 1 percent slopes, and of Clovis loam, 0 to 1 percent slopes, are included in many of the areas mapped.

Runoff is moderate following heavy, sudden rainstorms, but there is little, if any, runoff during gentle, soaking rains. Internal drainage is somewhat impeded by the layer of hard caliche. Under irrigation, this soil has a moderate rate of water intake. It is capable of holding a moderate amount of moisture that crops can use, and it is resistant to both wind and water erosion.

Wheat and grain sorghum are the principal crops in the dryfarmed areas. Peanuts, cotton, sweetpotatoes, and alfalfa are commonly grown under irrigation. If well managed, the range supports good or excellent stands of short grasses. *Dryland capability unit IIIce–2 if in climatic zone 3, and unit IVce–2 if in climatic zone 4; irrigated capability unit IIe–4; Loamy Upland range site.*

Stegall loam, 1 to 3 percent slopes (Su).—This soil is widely scattered throughout the county. The areas are small, but there is a fairly large acreage in the vicinity of Rogers.

The surface layer is noncalcareous, granular, dark-brown loam and is about 4 to 6 inches thick. The subsoil, which is moderately permeable, has moderate to strong, medium to coarse, prismatic structure. It is underlain at a depth of about 24 to 30 inches by a layer of hard caliche.

Included in the areas mapped are small areas of Clovis loam, 1 to 3 percent slopes, and small areas of medium-textured Portales soils.

Runoff on this soil is rapid following heavy rains of short duration, but it is moderate and less likely to cause erosion when rains are gentle and of longer duration. This soil has a moderate or slow rate of water intake, and it is capable of holding a moderate amount of moisture. Wind erosion is slight. Water erosion is moderate, and there are some scattered gullies.

Areas that are dryfarmed are suited to wheat and sorghum. Generally, these areas are terraced and farmed on the contour. The range supports fair to good stands of mid and short grasses. *Dryland capability unit IIIce–2 if in climatic zone 3, and unit IVce–2 if in climatic zone 4; irrigated capability unit IIIe–6; Loamy Upland range site.*

Stegall loam, shallow, 0 to 1 percent slopes (Sw).—This soil occurs throughout the Portales irrigated area, but it is not extensive.

The surface layer is brown or dark-brown loam. It has strong, medium, granular structure and is about 4 inches thick. The subsoil, which is about 10 inches thick, has moderate, medium, prismatic structure that breaks to subangular blocky structure. It is underlain abruptly by a layer of very hard caliche.

Included in the areas mapped are small areas of the more nearly level Potter soils and small areas of Stegall loam, 0 to 1 percent slopes.

This soil is relatively resistant to wind erosion. Runoff is moderate, and the rate of water intake and the permeability are moderate. The water-holding capacity is low. The layer of hard caliche restricts internal drainage and root growth. It also makes the digging of ditches for pipelines difficult.

If irrigated, this shallow soil is well suited to small grain, peanuts, and vegetables. However, it requires more frequent irrigation and a smaller quantity of water for each irrigation than moderately deep or deep soils. It is too shallow to be suited to dryfarmed crops. *Dryland capability unit VIe-4, climatic zone 3; irrigated capability unit IVe-13; Loamy Upland range site.*

Tivoli fine sand (5 to 25 percent slopes) (Tf).—This soil consists of deep, loose sands in the northern and southern parts of the county. The relief is rolling and dunelike, and the areas are known locally as the sandhills.

The surface layer of yellowish-red fine sand can be identified only by a slight darkening caused by organic stains. The rest of the soil material consists of loose sand and is many feet thick. The sand is noncalcareous and is permanently moist below a depth of 24 inches.

Small areas of Brownfield and Springer soils are included in some of the areas mapped.

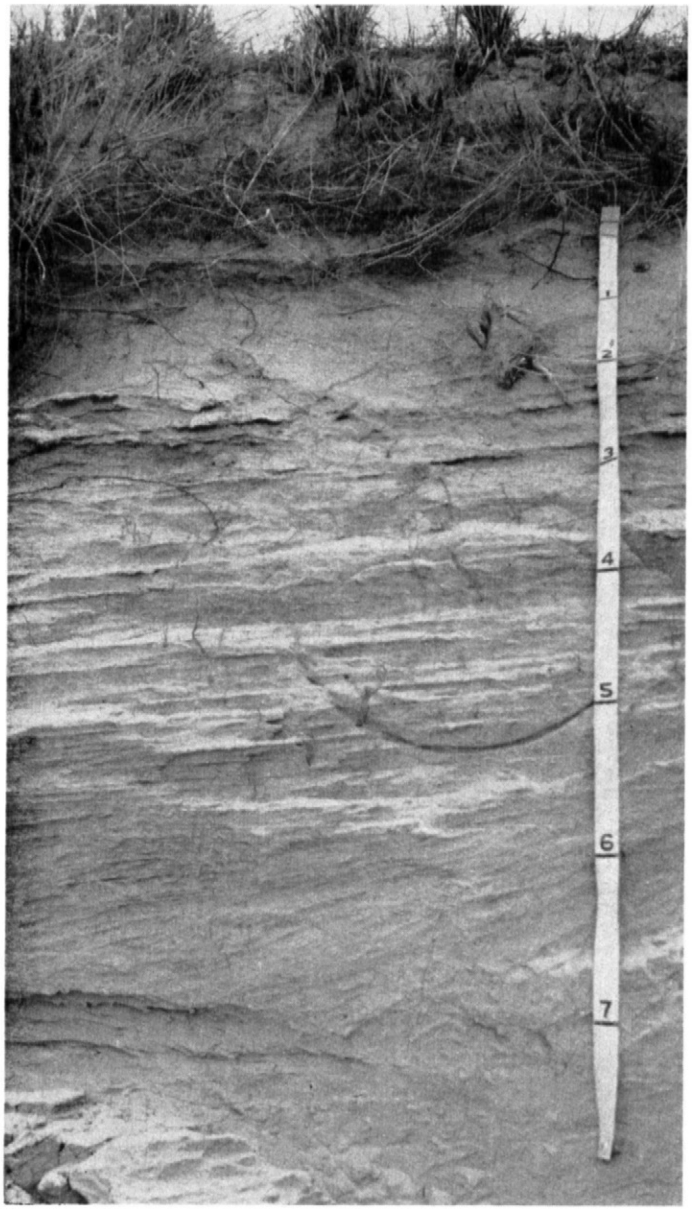

Figure 12.—Profile of Tivoli fine sand showing plant roots exposed by wind erosion.

The Tivoli soil has slight runoff and rapid internal drainage. It has little resistance to damage by wind. Normal geologic wind erosion is moderate or severe (fig. 12). The sandhills are considered to be valuable as catchment areas for the underground water storage basin of the Portales irrigated area and of other areas in the county.

This soil has little agricultural value, except for grazing. Tall grasses are the principal type of vegetation, but shin oak is invading the areas in the southern part of the county. Strict grazing control must be used in the management of these grasslands to prevent serious damage by wind erosion. *Dryland capability unit VIIe-1, climatic zones 3 and 4; Deep Sand range site.*

Tivoli-Arch complex (5 to 20 percent slopes) (Th).—This complex occurs in the sandhills north and east of Portales. The topography is characteristic of the sandhills in other parts of the county, except that there are depressions intermingled with duned areas of Tivoli soil. The moderately coarse textured Arch soil is in the depressions.

The Tivoli soil has a thin, loose, very coarse textured surface layer. It is underlain by the very sandy, single grained, structureless substratum. In places the Tivoli soil is slightly calcareous because of its close association with the calcareous Arch soil.

The Arch soil has a calcareous, moderately coarse textured surface layer. The surface layer is 6 inches thick and has weak granular structure. The subsoil has very weak subangular blocky to massive structure and is strongly calcareous. The underlying substratum is calcareous, light-gray to white, soft caliche.

The Tivoli soil is closely associated with Springer loamy fine sand, and the Arch soil is associated with the moderately coarse textured Portales and Zita soils. Small areas of these associated soils are included in the areas mapped.

Runoff on these soils is slight. On the Tivoli soil, internal drainage is excessive. On the Arch soil, runoff is slow and internal drainage is good.

The sandy Tivoli soil is not suited to crops, but it supports fair to good stands of tall and mid grasses. The Arch soil generally is not farmed but is suited to sorghum and sudangrass for pasture if water is available. The range supports stands of mid and short grasses. *Tivoli fine sand is in dryland capability unit VIIe-1, climatic zone 3; Deep Sand range site. Arch fine sandy loam is in dryland capability unit VIe-2, climatic zone 3; irrigated unit IVe-9; Limy Upland range site.*

Travessilla loam (5 to 15 percent slopes) (Tr).—This is a very shallow, light-colored soil that occurs in rough, broken, sloping areas in the panhandle section of the county, where it is associated with Hilly gravelly land. It is not extensive.

The surface layer is strongly calcareous, pale-brown to light yellowish-brown loam. It ranges from 6 to 8 inches in thickness. This thin layer overlies a light-colored substratum of mixed siltstone, shale, and weathered sandstone.

Included in the areas mapped are small areas of shallow Potter soils and of calcareous Mansker soils.

Internal drainage is slow, and runoff is rapid. This soil is not capable of holding even the limited amount of rainfall that it receives.

Wind erosion is slight, but on some strong slopes sheet erosion is severe, and in places gullies have formed.

This soil is too shallow and too steep for farming, but it can support fair stands of mid and short grasses. *Dryland capability unit VIIs-1, climatic zones 3 and 4; Shallow Upland range site.*

Zita fine sandy loam, 0 to 1 percent slopes (Zf).—This soil occupies slightly concave areas on smooth, level uplands.

The surface layer is about 6 inches of dark grayish-brown, noncalcareous, fine sandy loam. It has fine granular structure. The subsoil is about 12 to 18 inches of loam. It has weak prismatic structure and is calcareous in the lower part. The subsoil overlies a chalky, strongly calcareous, massive substratum that is several feet thick.

Small areas of the moderately coarse textured Portales soil and of Clovis fine sandy loam, 0 to 1 percent slopes, are included in some of the areas mapped.

Runoff is slight and generally is confined to these depressed areas. Internal drainage is good, permeability is moderate, and the water-holding capacity is low or moderate. Susceptibility to wind erosion is moderate.

If this soil is leveled for irrigation, cuts are limited by the layer of soft caliche, which occurs at a moderate depth. Root growth is also restricted by this layer.

Grain sorghum is the principal dryfarmed crop. Peanuts, cotton, and sweetpotatoes are grown under irrigation. Mixed mid grasses are dominant on the range. *Dryland capability unit IIIe-2 if in climatic zone 3, and unit IVe-6 if in climatic zone 4; irrigated capability unit IIe-9; Sandy Upland range site.*

Zita loam, 0 to 1 percent slopes (Zm).—This medium-textured soil occupies slightly concave areas on smooth, level uplands, mainly in the vicinity of Floyd and in the southeastern part of the county.

The surface layer is noncalcareous, dark grayish-brown loam. It has fine granular structure and is about 6 inches thick. The subsoil is 12 to 18 inches of sandy clay loam. It is similar to the surface layer in color but has weak prismatic structure. It is noncalcareous in the upper part but is increasingly calcareous with depth. This layer is underlain abruptly by a layer of white or very pale brown, strongly calcareous sandy clay loam.

Included in the areas mapped are small areas of the nearly level, medium-textured Portales soil and of Clovis loam, 0 to 1 percent slopes.

Runoff on the Zita soil is moderate but generally is confined to these depressed areas. Internal drainage is good, permeability is moderate, and the water-holding capacity is moderate. Wind erosion is slight or moderate. If this soil is leveled for irrigation, cuts are limited by the layer of soft caliche, which occurs at a moderate depth. This layer also restricts the depth of the root zone.

Wheat and grain sorghum are suitable crops if this soil is dryfarmed. Peanuts, cotton, and sweetpotatoes are grown under irrigation. The range supports good stands of mid and short grasses. *Dryland capability unit IIIce-2 if in climatic zone 3, and unit IVce-2 if in climatic zone 4; irrigated capability unit IIe-3; Loamy Upland range site.*

Use and Management of Soils

This section defines the two climatic zones in the county, explains the capability classification of soils for both dryfarmed and irrigated soils, and discusses the use and management of dryfarmed and irrigated soils by capability units. It also describes the rangeland of the county by range sites, suggests some measures for the improvement of wildlife habitats, and interprets soils data for engineering uses.

Climatic Zones

The amount of effective rainfall is a limiting factor in the production of crops in Roosevelt County. It is a factor to be considered both in the capability classification of soils and in soil management.

The State is divided into seven climatic zones mainly on the basis of the amount of effective precipitation received in an area, the evaporation and transpiration of moisture, and the seasonal occurrence of rainfall (*6*).[1] Zone 1 gets the most rainfall, and zone 7, the least. Roosevelt County is in climatic zones 3 and 4 (fig. 13).

In some areas of the county, irrigation water pumped from the underground water storage basin reduces the climatic hazard of insufficient rainfall. Thus, in the capability classification of soils, the climatic zone is shown only for nonirrigated soils. In climatic zone 3, the maximum capability classification is class III; in zone 4, the maximum classification is class IV. A soil that occurs in more than one climatic zone may be in more than one capability unit. The "Guide to Mapping Units" at the back of this report shows the relationship between climatic zones and the capability classification.

Capability Classification

The capability classification is a grouping of soils that shows, in a general way, how suitable these soil groups are for most kinds of farming. It is a practical grouping based on limitation of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, stony, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral; for example, IIe. The letter *e* shows that the main limitation is risk of erosion (wind and water) unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too dry or too cold.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses w, s, and c, because the soils in it are subject to little or no erosion but have other limitations that restrict their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their

[1] Italic numbers in parentheses refer to Literature Cited, p. 73.

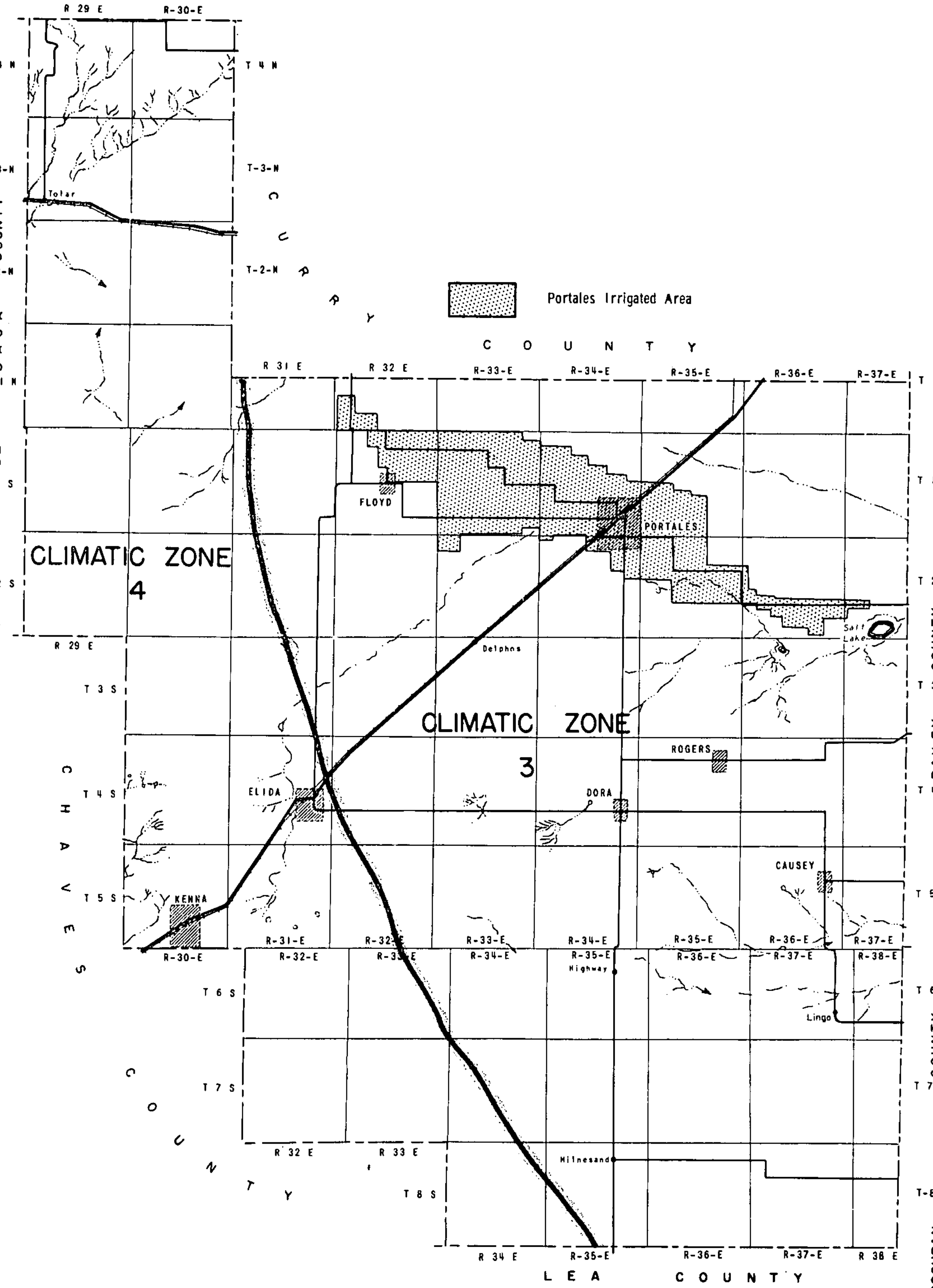

Figure 13.—**Climatic zones in Roosevelt County. Climatic zone 3 receives a greater amount of effective moisture than zone 4.**

permanent limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible, but unlikely, major reclamation projects.

General Management Practices for Dryland

Conservation of moisture and control of both wind and water erosion are the major problems confronting the farmers in Roosevelt County.

These problems are caused mainly by inadequate and irregular rainfall, torrential showers, blowing snow, hail, winds of long duration, wide fluctuation in yearly temperatures, a relatively short growing season, the uneven and steep slopes, and the compact subsoil.

Following is a discussion of some conservation practices needed on dryfarmed soils for the effective control of erosion and the conservation of moisture. These practices can be used singly or in combination depending on the kind of soil, the degree of slope, and the nature of the particular conservation problem. The use of commercial fertilizers to increase production on dryfarmed crops has not proven feasible. Lack of moisture, not fertility, is the major factor limiting crop yields.

Cropping System.—A cropping system consists of a sequence of crops grown on a given area over a period of time. It may be made up of a regular rotation of different crops, grown in a definite order, or of the same crop, grown year after year in the same area.

Cropping systems for dryland are restricted in this county by the limited variety of crops suited to climatic conditions. The supply of moisture is low, and the growing season is relatively short. Consequently, wheat and sorghum are the principal dryfarmed crops, but the cropping sequence varies widely among farm operators. Because of low rainfall, farmers in the wheat-growing areas often include a fallow period in the cropping sequence so that moisture can accumulate in the subsoil before the seeding of the next crop. Common cropping systems in wheat-growing areas are: continuous wheat; wheat, sorghum, fallow; and alternate wheat and delayed fallow. Systems commonly used in areas where row crops are grown are: continuous sorghum for silage, bundle feed, or grain; and alternate sorghum and broomcorn. Some cropping systems include sudangrass, which is used for the grazing of livestock, bundle feed, or seed.

If grown as a dryfarmed crop, cotton leaves little residue. This lack of residue, particularly on sandy soils, makes the control of wind erosion difficult.

Stubble Mulching and Use of Crop Residue.—The management of crop residues is an important conservation measure to protect dry cropland from wind erosion.

Stubble mulching is particularly well suited to wheat-producing areas (fig. 14). It provides a protective cover that prevents wind from striking the soil surface, and it also provides organic material needed to help stabilize aggregates in the surface layer. Stubble-mulch tillage helps to control weeds and causes the least disturbance to surface residue (fig. 15).

***Figure 14.*—A bumper wheat crop provides abundant straw that protects the soil.**

***Figure 15.*—Stubble mulching on wheatland.**

Crop residues provide a protective cover on the soils during the critical erosion period, which generally is during fall, winter, and spring. The maintenance of standing residue through this critical period also helps to trap snow and increase moisture storage (fig. 16). If dryland is plowed early in winter, the residues needed to protect the soils will be destroyed.

In dry years, when the residue is thin (fig. 17), emergency tillage can be used to supplement the use of residues for the control of wind erosion.

Emergency Tillage.—Emergency tillage is any tillage performed for the purpose of roughening the soil surface to minimize wind erosion. It is used if there is danger of soil damage because the vegetation is not sufficient to prevent soil blowing or the soil is not cloddy enough or rough enough to resist erosion. Tillage methods vary according to the texture of the soil and the stability of the clods.

Tillage methods applicable to medium-textured soils.—If the soils are compact, use narrow chisels to bring up stable clods. If they are loose, use broad, shovel-type chisels or listers. Till across the direction of the prevailing wind, beginning on the windward side of the field. The wide spacing of furrows on the first operation may permit the salvaging of part of a growing wheat crop. The close spacing of furrows tends to pulverize the surface layer and to increase soil blowing. On undisturbed soils, if the effect of chiseling is destroyed by wind or moisture, run chisels between old furrows. Tillage is most effective if undertaken at a speed of 3½ or 4 miles per hour. Excessive speed pulverizes clods.

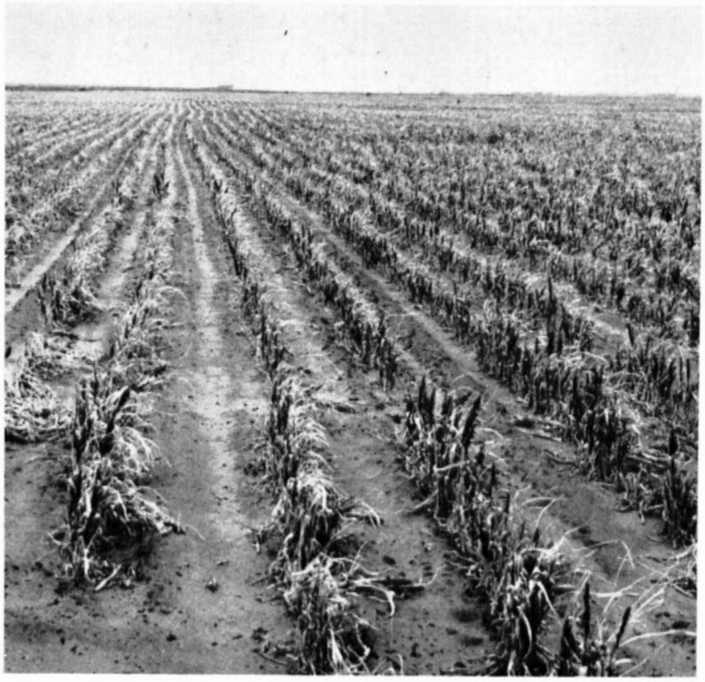

Figure 16.—**Good residue cover.**

Tillage methods applicable to moderately coarse-textured soils.—Solid list at a shallow depth to create rough ridges. Row crops should be listed in the old middles so that stalks will be left standing. If listing is needed again, it should be done at progressively greater depths to bring up clods, either in the middles or in old furrows.

Tillage methods applicable to unstable, calcareous, and coarse-textured soils.—Deep listing to create a rough surface protects coarse-textured soils temporarily against wind damage, but the use of crop residues is a more effective way to minimize wind erosion.

Figure 17.—**Poor residue cover.**

Deep Plowing.—Deep plowing to control wind erosion is suitable only if the surface layer is moderately coarse textured or coarse textured and the subsoil is sandy clay loam and is within plow depth. The depth of plowing ranges from 16 to 26 inches. For good results, a fourth to a third of the furrow slice should be of the finer textured subsoil material. The soil then can be roughened to give some protection against wind erosion.

After a soil is deep plowed, crops that produce large amounts of residue are needed to maintain stability. In some places, deep plowing is useful to stabilize the soil and to produce sufficient stubble cover in which to reseed old fields to native grasses.

Contour Farming.—Contour farming in combination with terraces helps to conserve both soil and water. Contour farming without terraces is used only on moderately coarse textured and medium-textured soils that are on fairly uniform slopes.

Capability groups of dryfarmed soils

The eight classes in the capability system and the subclasses and units recognized for dryfarmed soils in Roosevelt County are described in the list that follows. The capability units in this list are not all numbered consecutively, because the grouping is statewide, and not all the capability units in the State are represented in this county.

Class I. Soils that have few limitations that restrict their use. There are no class I soils in Roosevelt County because of the potential wind-erosion hazard and the lack of moisture.

Class II. Soils that have some limitations that reduce the choice of plants or that require moderate conservation practices. There are no dryland class II soils in Roosevelt County because of the potential wind-erosion hazard and the lack of moisture.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected. Wind erosion is the primary erosion hazard in Roosevelt County.
  - Unit IIIe-1. Deep soils that have a moderately coarse textured surface layer and a moderately permeable subsoil. A caliche layer occurs below a depth of 36 inches.
  - Unit IIIe-2. Deep or moderately deep, moderately coarse textured soils that have a moderately permeable subsoil. A caliche layer occurs at a depth of 20 to 36 inches or more.
- Subclass IIIce. Soils that have severe limitations because of wind erosion and drought.
  - Unit IIIce-1. Deep soils that have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil.
  - Unit IIIce-2. Soils that have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil. A caliche layer at a depth of 20 to 36 inches or more limits the depth of the root zone.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected. Wind erosion is the primary hazard in Roosevelt County.

Unit IVe–1. Deep soils that have a moderately coarse textured surface layer and a moderately permeable subsoil of sandy clay loam.

Unit IVe–2. Moderately deep, calcareous soils that have a medium-textured surface layer and a moderately permeable subsoil of sandy clay loam or loam.

Unit IVe–3. Moderately deep, calcareous soils that have a fine sandy loam surface layer and a moderately permeable subsoil.

Unit IVe–4. Deep or moderately deep soils that have a coarse-textured surface layer and a moderately permeable sandy clay loam subsoil.

Unit IVe–6. Moderately deep soils that have a moderately coarse textured surface layer and a moderately permeable sandy clay loam subsoil.

Subclass IVce. Soils that have very severe limitations because of low moisture and erosion. These soils normally receive less rainfall than similar soils in climatic zone 3.

Unit IVce–1. Deep soils that have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil.

Unit IVce–2. Moderately deep soils that have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover. There are no Class V soils in Roosevelt County.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to range, pasture, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit VIe–1. Deep to shallow soils that have a sandy surface layer and a moderately permeable subsoil.

Unit VIe–2. Calcareous soils that have a medium-textured or moderately coarse textured surface layer and a moderately permeable subsoil.

Unit VIe–3. Soils that have a coarse-textured surface layer and a moderately permeable or rapidly permeable subsoil.

Unit VIe–4. Shallow, medium-textured soils that have rocklike caliche at a depth of 20 to 24 inches.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation. In Roosevelt County, these soils occur in playas and drainage systems and are subject to occasional flooding and overflow.

Unit VIw–1. Deep, slowly permeable, clayey soils that occupy broad, flat depressions.

Unit VIw–2. Deep, slowly permeable, clayey soils that occupy the bottoms of playas.

Unit VIw–3. Deep, moderately permeable soils that occur in drainageways and draws.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit VIIe–1. Deep, coarse-textured soils that have a moderately permeable to very rapidly permeable subsoil.

Subclass VIIs. Soils very severely limited by moisture capacity, gravel, or other soil features.

Unit VIIs–1. Shallow or very shallow soils on nearly level to steep slopes.

Unit VIIs–2. Shallow, gravelly soils on low, rounded hills and ridges.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIw. Extremely wet or marshy land.

Unit VIIIw–1. Loose sand and gravel in intermittent drainage channels.

In the following pages, the soils of Roosevelt County are arranged in capability units for dryland farming. The significant features of the soils in each unit, together with their hazards and limitations, are described, and some suggestions for use and management are given. The appropriate climatic zone is shown in parentheses following the capability unit.

CAPABILITY UNIT IIIe–1 (CLIMATIC ZONE 3)

The soils of this unit are deep, and they have a moderately coarse textured surface layer and a moderately permeable subsoil. A layer of caliche occurs below a depth of 36 inches. The soils in this unit are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.

These soils are moderately susceptible to wind erosion. They have lower water-holding capacity than the Amarillo and Olton loams of capability unit IIIce–1, but they have a higher rate of water intake than those medium-textured soils and consequently are less droughty.

Wheat, sorghum, or some other crop that leaves a large amount of residue on the surface is needed about 2 years in 3. Proper management of the residue adds organic matter to the soils and helps to control wind erosion. If the cover is not sufficient to control wind erosion, listing or chiseling may be necessary. Emergency tillage, however, has only a temporary effect and may have to be repeated during the year.

Lack of moisture, not lack of fertility, limits the productivity of these soils. Farming on the contour and terracing help to conserve moisture. Terraces also help to control water erosion on the gently sloping soils but may not be needed if a drilled crop of sorghum or of small grain is grown every year and the residue is left on the surface.

These soils produce grasses common to the Sandy Upland range site, including little bluestem, sideoats grama, blue grama, and black grama.

CAPABILITY UNIT IIIe-2 (CLIMATIC ZONE 3)

This unit consists of deep or moderately deep, moderately coarse textured soils that have a moderately permeable subsoil. A layer of caliche occurs at a depth of 20 to 36 inches or more. The soils in this unit are—

Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Clovis fine sandy loam, 0 to 1 percent slopes.
Clovis fine sandy loam, 1 to 3 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

These soils are slightly or moderately susceptible to wind erosion. They are lower in available moisture capacity than the medium-textured soils of unit IIIce-1, but they are less droughty because water enters them more readily.

Conservation measures to help control wind erosion are cross-wind tillage, emergency tillage, the use of blades or sweeps to maintain crop residues on or near the surface, and control of grazing.

Supplemental practices may be required on these soils. These include chiseling to break a tillage pan, flat furrow plowing to improve surface texture and provide better seedbeds, and stubble mulching on soils used for row crops. Terracing may be desirable on the gentle slopes. A high-residue crop needs to be grown 2 years in 3. A suitable cropping system consists of wheat, sorghum; continuous sorghum or broomcorn; or sudangrass for pasture.

The range supports good stands of little bluestem, sideoats grama, blue grama, black grama, and other grasses that ordinarily grow on soils of the Sandy Upland range site.

CAPABILITY UNIT IIIce-1 (CLIMATIC ZONE 3)

The soils in this unit are deep, and they have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil. They are—

Amarillo loam, 0 to 1 percent slopes.
Amarillo loam, 1 to 3 percent slopes.
Olton loam, 0 to 1 percent slopes.
Olton-Zita loams, 0 to 1 percent slopes (Olton loam only).

Wind erosion is only a slight hazard on the soils in this unit. Water erosion is a more serious hazard because of runoff on the stronger slopes.

The capacity of these soils to store moisture and plant nutrients is high, but management is needed to maintain the content of organic matter. A cover crop or crop residues can be used to help control both wind and water erosion, or the surface can be kept rough and cloddy.

A crop that leaves a large amount of residue on the surface should be grown every other year on the level or nearly level soils and 2 years in 3 on the gently sloping soils. Listing or chiseling may be needed if the amount of residue is not sufficient to control wind erosion. Terraces are needed in most gently sloping areas to control erosion and to conserve moisture but generally are not required on short slopes if drilled wheat or sorghum is grown and residues are left on the surface. Terraces also help to conserve moisture on the level or nearly level soils. Contour farming in combination with terracing is effective in conserving moisture and controlling erosion.

The soils in this unit are productive of buffalograss, blue grama, sideoats grama, little bluestem, and other grasses that ordinarily grow on soils of the Loamy Upland range site.

CAPABILITY UNIT IIIce-2 (CLIMATIC ZONE 3)

The soils of this unit have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil. A caliche layer, which occurs at a depth of 20 to 36 inches or more, limits the depth of the root zone. The soils of this unit are—

Blackwater loam.
Clovis loam, 0 to 1 percent slopes.
Clovis loam, 1 to 3 percent slopes.
Olton-Zita loams, 0 to 1 percent slopes (Zita loam only).
Stegall loam, 0 to 1 percent slopes.
Stegall loam, 1 to 3 percent slopes.
Zita loam, 0 to 1 percent slopes.

These soils are only slightly susceptible to wind erosion. In years of subnormal moisture, they are more droughty than the more sandy soils in the county.

To help control wind erosion, a vegetative cover is needed on soils that are fallowed through the period from harvest until spring. Practices needed to conserve moisture and to control erosion are stubble mulching, farming on the contour, and chiseling to break the tillage pan or the compact subsoil. Terraces are needed in some fields. Emergency tillage is necessary in fields that lack cover sufficient to control soil blowing.

These soils are productive of grasses that ordinarily grow on soils of the Loamy Upland range site.

CAPABILITY UNIT IVe-1 (CLIMATIC ZONE 4)

This unit consists of deep soils that have a moderately coarse textured surface layer, and a moderately permeable subsoil of sandy clay loam. A friable calcareous layer occurs at a depth of 36 to 48 inches. The soils in this unit are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.

Because of the limited amount of rainfall in climatic zone 4, crop failures occur more frequently than in climatic zone 3, or about 3 times in every 4 years. Thus, wind erosion is a severe hazard if these soils are cultivated.

A high-residue crop should be grown 2 years in 3. If an adequate cover crop is not produced, emergency tillage may be necessary to create a rough surface that will temporarily control erosion. Contour farming and terracing are desirable on slopes of 1 to 3 percent to conserve water and to help control erosion.

CAPABILITY UNIT IVe-2 (CLIMATIC ZONE 3)

This unit consists of moderately deep, calcareous soils that have a medium-textured surface layer and a moderately permeable subsoil of loam or sandy clay loam. The soils in this unit are—

Portales loam, 0 to 1 percent slopes.
Mansker and Portales loams, 1 to 3 percent slopes.

If clods are brought to the surface, they break readily into fine aggregates that are easily moved by wind. Therefore, if cultivated, these soils are moderately susceptible to wind erosion. To help control wind erosion and to maintain productivity, it is necessary to leave sufficient crop residues on or near the surface throughout the year

and to restrict grazing. Stubble mulching is a good practice on wheatland. Tillage crosswise to the direction of the prevailing wind is desirable.

A suitable cropping system consists of growing such high-residue crops as sorghum and broomcorn 3 years in 4. Emergency tillage (listing and chiseling) may be necessary if the amount of residue is not sufficient to control erosion. On gentle slopes, terracing and farming on the contour help to control runoff and to conserve moisture. Terracing may not be necessary if a drilled crop of small grain or of sorghum is grown every year, and if the residue is left on the surface.

Areas of these soils that are now in grass should be cultivated only after their limitations as farmland have been evaluated. Blue grama and buffalograss are the principal grasses on the range.

CAPABILITY UNIT IVe-3 (CLIMATIC ZONE 3)

This unit consists of moderately deep, calcareous soils that have a moderately permeable subsoil. The surface layer is fine sandy loam, and the subsoil is loam or sandy clay loam. These soils are similar to the soils of capability unit IVe-2, except that the surface layer is sandier. The soils of this unit are—

Mansker and Portales fine sandy loams, 1 to 3 percent slopes.
Portales fine sandy loam, 0 to 1 percent slopes.

Because of the sandy surface layer, wind erosion is a serious hazard on these soils. Practices that help to control wind erosion are careful use of crop residues, cross-wind tillage or contour farming, and emergency tillage. If these soils are to be seeded to perennial grass, a cover crop of sorghum is needed to protect them until the grass is established.

Suitable crops are continuous sorghum, sudangrass for pasture, or perennial grass. The principal grasses on the range are little bluestem, sideoats grama, and black grama.

CAPABILITY UNIT IVe-4 (CLIMATIC ZONE 3)

The soils of this unit are deep or moderately deep. They have a coarse-textured surface layer and a moderately permeable subsoil of sandy clay loam. The soils of this unit are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Arvana loamy fine sand, 0 to 3 percent slopes.
Clovis loamy fine sand, 0 to 3 percent slopes.

These soils are less droughty than the finer textured soils of the county because the rate of moisture intake is rapid. Consequently, during seasons of subnormal moisture, they are more productive than many of the other soils in the county. However, wind erosion is a serious hazard.

These soils need to be protected by a cover crop throughout the year. Good management includes growing a high-residue crop 3 years in 4, leaving crop residues on or near the surface, and stubble mulching fields used to grow row crops. Cross-wind tillage is also desirable. The stubble left on these fields should not be grazed. If these soils are to be retired and planted to grass, deep breaking will help to establish a good cover crop in which to seed grass.

CAPABILITY UNIT IVe-6 (CLIMATIC ZONE 4)

This unit consists of moderately deep soils that have a moderately coarse textured surface layer and a moderately permeable subsoil of sandy clay loam. The soils in this unit are—

Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Clovis fine sandy loam, 0 to 1 percent slopes.
Clovis fine sandy loam, 1 to 3 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

Because of the limited amount of rainfall in climatic zone 4, crop yields are above average only about 1 year in 4. In other years, crop failures may occur. Therefore, if these soils are cultivated, wind erosion is a serious hazard.

These soils are best suited to high-residue crops. If the crop cover is not adequate, listing may be needed to create a rough surface for the temporary control of wind erosion. On gentle slopes, terracing or farming on the contour, or both, are helpful in conserving moisture.

CAPABILITY UNIT IVce-1 (CLIMATIC ZONE 4)

The soils of this unit are deep. They have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil. They are—

Amarillo loam, 0 to 1 percent slopes.
Amarillo loam, 1 to 3 percent slopes.
Olton loam, 0 to 1 percent slopes.
Olton-Zita loams, 0 to 1 percent slopes (Olton loam only).

These soils are productive if rainfall is adequate. However, in climatic zone 4, rainfall sufficient for the effective growth of crops occurs only about once every 4 years. Consequently, the risk of wind erosion is moderate or severe if these soils are cultivated.

A vegetative cover, left on or near the surface throughout the year, is needed to help control wind erosion. If lack of moisture prevents the production of sufficient crop residues for this purpose, emergency tillage will be required. Cross-wind tillage or contour farming in combination with terracing is desirable on slopes of 1 to 3 percent. It is desirable to include a high-residue crop in the cropping system 2 years in 3.

CAPABILITY UNIT IVce-2 (CLIMATIC ZONE 4)

This unit consists of moderately deep, nearly level or gently sloping soils that have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil. The soils of this unit are—

Clovis loam, 0 to 1 percent slopes.
Clovis loam, 1 to 3 percent slopes.
Mansker and Portales loams, 1 to 3 percent slopes (Portales loam only).
Olton-Zita loams, 0 to 1 percent slopes (Zita loam only).
Portales loam, 0 to 1 percent slopes.
Stegall loam, 0 to 1 percent slopes.
Stegall loam, 1 to 3 percent slopes.
Zita loam, 0 to 1 percent slopes.

The proper management of residue is necessary to keep these soils productive. If subsoil moisture is adequate, wheat can be grown. A high-residue crop needs to be grown 2 years in 3 to help control wind erosion. If the residue produced is not adequate for this purpose, these soils can be listed or chiseled to form a rough surface. Terracing and farming on the contour are desirable on slopes of 1 to 3 percent to conserve moisture and to help control erosion.

CAPABILITY UNIT VIe-1 (CLIMATIC ZONE 3)

This unit consists of deep to shallow soils that have a sandy surface layer and a moderately permeable subsoil. The soils in this unit are—

- Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded.
- Arvana loamy fine sand, shallow, 0 to 1 percent slopes.
- Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
- Berthoud sandy loam, 2 to 9 percent slopes.

These soils are very susceptible to wind erosion. Although their capacity to hold water and plant nutrients is moderate or low, there is little runoff, and most of the water received is available for plants.

The soils in this unit are not suitable for dryland farming. If used for range, they are best suited to a mixture of mid and short grasses, but careful management is needed to control erosion.

The section "Range Management" discusses the use and management of these soils for range.

CAPABILITY UNIT VIe-1 (CLIMATIC ZONE 4)

This unit consists of deep, moderately deep, or shallow soils that have a sandy surface layer and a moderately permeable subsoil. The soils in this unit are—

- Amarillo loamy fine sand, 0 to 3 percent slopes.
- Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded.
- Arvana loamy fine sand, 0 to 3 percent slopes.
- Arvana loamy fine sand, shallow, 0 to 1 percent slopes.
- Berthoud sandy loam, 2 to 9 percent slopes.
- Clovis loamy fine sand, 0 to 3 percent slopes.
- Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Portales soil only).
- Portales fine sandy loam, 0 to 1 percent slopes.

These soils are in a zone of limited rainfall and are not suited to crops that would produce enough residue to control soil blowing. Thus, they cannot be farmed safely. The range supports mid and short grasses.

The section "Range Management" discusses the use and management of these soils for range.

CAPABILITY UNIT VIe-2 (CLIMATIC ZONES 3 AND 4)

This unit consists of calcareous soils that have a medium-textured or moderately coarse textured surface layer and a moderately permeable subsoil. The soils in this unit are—

- Arch loam.
- Arch fine sandy loam.
- Arch soils, severely eroded.
- Drake soils.
- Mansker and Portales loams, 1 to 3 percent slopes (Mansker soil only; climatic zone 4, only).
- Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Mansker soil only; climatic zone 4, only).
- Tivoli-Arch complex (Arch soil only; climatic zone 3, only).

These soils have a moderate rate of water intake and are capable of holding most of the moisture that they receive. They are moderately susceptible to wind erosion and are not suitable for dryland farming. They can be used for range. The best suited grasses are sideoats grama and alkali sacaton.

The section "Range Management" discusses the use and management of these soils for range.

CABABILITY UNIT VIe-3 (CLIMATIC ZONES 3 AND 4)

The soils in this unit have a coarse-textured surface layer and a moderately permeable or rapidly permeable subsoil. They are—

- Arch loamy fine sand.
- Brownfield fine sand.
- Gomez loamy fine sand.
- Springer loamy fine sand.
- Springer soils, severely eroded.

These soils have a rapid rate of water intake, and they are capable of holding most of the moisture that they receive. The Brownfield soils have a moderately permeable subsoil, and the Springer soils a rapidly permeable subsoil. The soils in this unit are susceptible to severe wind erosion and need careful management to prevent their being overgrazed or otherwise damaged by livestock. The common grasses are little bluestem, sand bluestem, and sideoats grama.

The section "Range Management" discusses the use and management of these soils for range.

CAPABILITY UNIT VIe-4 (CLIMATIC ZONE 3)

There is only one soil in this unit, Stegall loam, shallow, 0 to 1 percent slopes. This soil occurs in small areas in the Portales irrigated area. It has a thin surface layer and a thin, moderately permeable subsoil. A layer of hard caliche occurs at a depth of about 20 to 24 inches.

This soil has moderate runoff, low water-holding capacity, and slow internal drainage. Root growth is restricted by the layer of hard caliche. Water erosion and wind erosion are slight.

Blue grama and bufflalograss are the principal grasses on the range. Range pitting and the construction of silos and water diversions are difficult on this shallow soil.

The section "Range Management" discusses the use and management of this soil for range.

CAPABILITY UNIT VIw-1 (CLIMATIC ZONES 3 AND 4)

Montoya clay loam is the only soil in this unit. This soil has a slow rate of water intake and is slowly permeable. It occurs in broad, flat depressions and receives water from higher lying areas. It is readily eroded by water, and in places there are deep, V-shaped gullies (fig. 18). Gullies commonly originate in old roads, trails, or areas where the vegetation has been destroyed.

Tobosa is the dominant grass on the range. The section "Range Management" discusses the use and management of this soil for range.

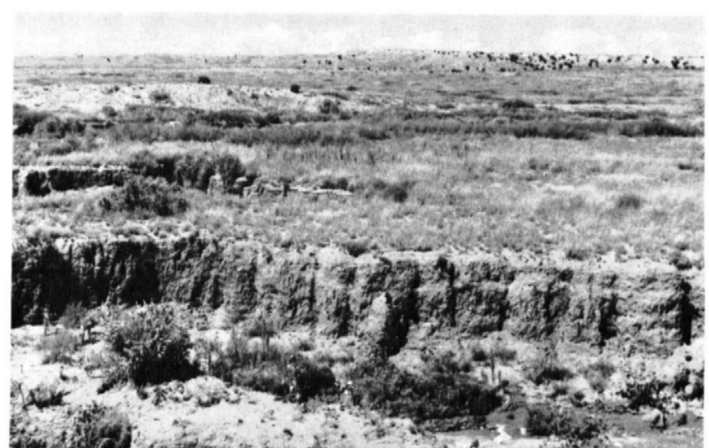

Figure 18.—**Gully erosion on Montoya clay loam.**

CAPABILITY UNIT VIw-2 (CLIMATIC ZONES 3 AND 4)

This unit consists of deep, clayey soils that occupy the bottoms of many playas that are intermittently covered with water. The soils in this unit are—

Church clay loam
Church soils, severely eroded.

These soils have a slow rate of water intake and are slowly permeable. They are susceptible to severe wind erosion if the range is overgrazed. Alkali sacaton is the dominant grass on the range.

The section "Range Management" discusses the use and management of these soils for range.

CAPABILITY UNIT VIw-3 (CLIMATIC ZONES 3 AND 4)

This unit consists of only the Bippus and Spur soils. These soils are deep and moderately permeable. They occur in draws and drainageways and are flooded for short periods during intense rainstorms. The floodwater generally benefits range plants.

Most areas of these soils are so narrow and irregular that they are not suitable for farming. The larger areas, however, can be farmed if runoff is controlled. The soils in these larger areas can be managed in the same way as the soils in capability unit IIIce-1, climatic zone 3; unit IVce-1, climatic zone 4; and unit IIIe-3, irrigated.

Sideoats grama and vine-mesquite are the dominant grasses on the range. The section "Range Management" discusses the use and management of these soils for range.

CAPABILITY UNIT VIIe-1 (CLIMATIC ZONES 3 AND 4)

This unit consists of light-colored, loose, sandy soils that are typical of the sandhill section of the county. The topography is rolling and dunelike. The soils in this unit are—

Blown-out and dune land.
Brownfield soils, severely eroded.
Tivoli fine sand.
Tivoli-Arch complex (Tivoli soil only; climatic zone 3, only).

The soils in this unit are too sandy for cultivation, but they support good stands of grass for grazing. However, their carrying capacity must be restricted because overgrazing and drought cause active soil blowing. The dunes, which form once blowing is started, are extremely difficult to stabilize. These soils are valuable as catchment areas for rainfall.

The section "Range Management" discusses the use and management of these soils for range.

CAPABILITY UNIT VIIs-1 (CLIMATIC ZONES 3 AND 4)

This unit consists of shallow or very shallow soils on nearly level to steep slopes. The soils are—

Arvana soils, 0 to 3 percent slopes, severely eroded.
Kimbrough fine sandy loam.
Kimbrough loam.
Potter soils, 0 to 9 percent slopes.
Rough broken land.
Travessilla loam.

These soils have a moderate rate of water intake and low water-holding capacity. Nevertheless, grasses make good use of rainfall because most of the moisture received is readily available to plants. Wind erosion is a moderate hazard.

These shallow soils are not suitable for cultivation. The principal grasses on the range are sideoats grama, little bluestem, and black grama. The common shrubs are snakeweed, small soapweed, and cactus.

The section "Range Management" discusses use and management of these soils for range.

CAPABILITY UNIT VIIs-2 (CLIMATIC ZONES 3 AND 4)

This unit consists of Hilly gravelly land, which occurs on low rounded hills and ridges, mainly in the panhandle section and in climatic zone 4 in the western part of the county. A few scattered areas occur throughout climatic zone 3. There are many rounded, waterworn, igneous pebbles both on the surface and throughout the soil material.

The rate of water intake is moderate or high, internal drainage is good, and runoff is moderate. Erosion by water is moderate, and erosion by wind is slight.

This land is too shallow over gravel or rock to be cultivated. It is best suited to native grasses. The common grasses are black grama, blue grama, and sideoats grama.

The section "Range Management" discusses the use and management of Hilly gravelly land for range.

CAPABILITY UNIT VIIIw-1 (CLIMATIC ZONES 3 AND 4)

This unit is made up entirely of Riverwash. Riverwash consists mainly of loose sand and gravel on bottoms along large intermittent drainageways. It is unstable and has little agricultural value. Saltcedar has invaded some areas, and there are a few scattered groves of cottonwood. Small water-retarding structures have been constructed in places to provide temporary watering sites for cattle. Areas of Riverwash that are adjacent to pastured areas can be used to some extent for grazing, but this land is not shown in a range site.

Estimated yields of dryland crops

Table 2 shows estimated average acre yields of crops on the principal dryfarmed soils of Roosevelt County. Yields are given for two levels of management. Those in columns A are yields to be expected under ordinary management. This level of management includes only minimum conservation practices that help to control erosion and to conserve moisture. The ratings in columns B are those that could be obtained under the better management practices suggested in the individual capability units.

Yield data are based on records kept on selected farms and on precipitation records.

Because of variations in the amount and distribution of rainfall, crop failures can occur. Consequently, the yields shown in table 2 cannot be obtained each year.

General Management Practices for Irrigated Land

Control of erosion, maintenance of productivity, and efficient use of irrigation water are the major problems in the management of irrigated soils in Roosevelt County (fig. 19). Following is a discussion of conservation practices designed for irrigation farming. These practices can be used singly or in combination, depending on the kind of soil, the slope, and the availability of water.

Soil-Moisture Relationship.—An irrigator can work best if he knows the readily available moisture of the soil

Table 2.—*Estimated average acre yields of crops on the principal dryfarmed soils under two levels of management*

[Yields in columns A are those obtained under common management; yields in columns B are those obtained under improved management; absence of yield indicates crop is not generally grown on the soil at the level of management specified; soils and land types not listed are normally not suited to or generally not used for the crops named]

Soil	Climatic zone 3				Climatic zone 4			
	Wheat		Grain sorghum		Wheat		Grain sorghum	
	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Lb.*	*Lb.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*
Amarillo loamy fine sand, 0 to 3 percent slopes	------	------	750	950	------	------	650	800
Amarillo fine sandy loam, 0 to 1 percent slopes	8	10	900	1, 200	4	8	800	1, 000
Amarillo fine sandy loam, 1 to 3 percent slopes	8	10	900	1, 200	4	8	800	1, 000
Amarillo loam, 0 to 1 percent slopes	8	12	825	1, 075	6	10	700	900
Amarillo loam, 1 to 3 percent slopes	8	12	825	1, 075	6	10	700	900
Arvana loamy fine sand, 0 to 3 percent slopes	------	------	700	900	------	------	------	------
Arvana fine sandy loam, 0 to 1 percent slopes	8	10	900	1, 200	4	8	800	1, 000
Arvana fine sandy loam, 1 to 3 percent slopes	8	10	900	1, 200	4	8	800	1, 000
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	6	8	800	900	4	8	750	850
Blackwater loam	------	------	700	850	------	------	------	------
Clovis loamy fine sand, 0 to 3 percent slopes	------	------	750	950	------	------	650	850
Clovis fine sandy loam, 0 to 1 percent slopes	8	10	900	1, 200	4	8	800	1, 000
Clovis fine sandy loam, 1 to 3 percent slopes	8	10	900	1, 200	4	8	800	1, 000
Clovis loam, 0 to 1 percent slopes	8	12	825	1, 000	6	10	700	900
Clovis loam, 1 to 3 percent slopes	8	12	825	1, 000	6	10	700	900
Mansker and Portales fine sandy loams, 1 to 3 percent slopes	------	------	575	700	------	------	------	------
Mansker and Portales loams, 1 to 3 percent slopes	------	------	600	800	------	------	------	------
Olton loam, 0 to 1 percent slopes	------	------	800	1, 000	------	------	------	------

and the amount of water needed to refill the root zone to field capacity.

Readily available moisture is the moisture that the plant can get and maintain rapid growth. Field capacity is the amount of moisture in a soil 2 or 3 days after a good irrigation or a heavy rain. At field capacity, the soil contains all of the water it can hold against the force of gravity. Water has drained out of the large pores, but with respect to practical water-holding capacity, the root zone is 100 percent filled with water. At field capacity, clay loams or loams hold about 2 inches of readily available moisture per foot, sandy loams and loamy sands hold about 1 inch, and fine sands about 0.7 inch.

It is best to irrigate a crop just before the readily available moisture is used up. In table 3 the total readily available moisture is expressed in inches for most of the soil types in the county. It is the inches of water needed to bring the soil to field capacity when a rapidly growing crop such as alfalfa needs irrigation. The figures given do not include ditch loss or loss from evaporation.

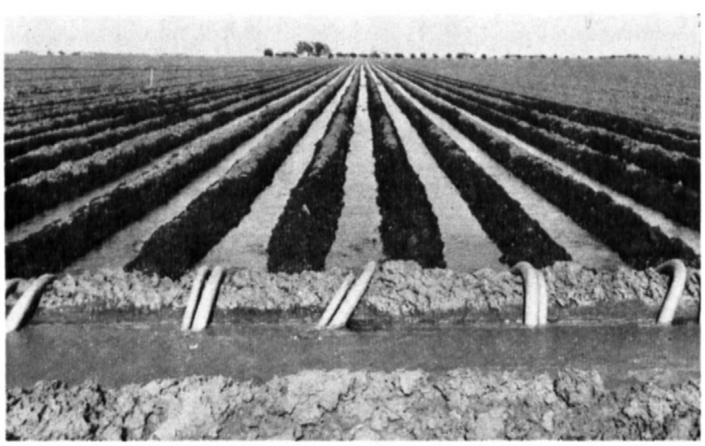

***Figure 19.*—Irrigation on leveled land.**

These readily available moisture values were derived from irrigation trials in the Portales area and from data reported by Diebold (*2*) in New Mexico and neighboring States.

Cropping Systems.—The cropping system for irrigated land depends to a great extent on the type of soil, the farmer's needs, plant diseases, and markets. Under irrigation, crops such as alfalfa, grass, sweetclover, sweet-

Table 3.—*Thickness of root zone and available moisture capacity of root zone in soils of representative types*

Soil type	Approximate thickness of root zone	Readily available moisture capacity
	Inches	*Inches*
Amarillo loamy fine sand	36 to 60	4 to 4½
Amarillo fine sandy loam	36 to 60	4 to 5
Amarillo loam	36 to 60	5 to 6
Arch fine sandy loam	10 to 20	2 to 2½
Arch loam	10 to 20	2 to 3
Arvana loamy fine sand	20 to 36	2 to 3½
Arvana fine sandy loam	20 to 36	2½ to 4
Arvana fine sandy loam, shallow	10 to 20	1½ to 2½
Blackwater loam	16 to 18	2½ to 3
Clovis loamy fine sand	20 to 36	2½ to 4
Clovis fine sandy loam	20 to 36	3 to 4
Clovis loam	20 to 36	4 to 5
Drake loam	20 to 36	4 to 5
Gomez loamy fine sand	20 to 36	2½ to 4
Mansker loam	20 to 26	3 to 4
Portales fine sandy loam	20 to 36	3 to 4
Portales loam	20 to 36	4 to 5
Stegall loam	20 to 30	3½ to 4½
Stegall loam, shallow	10 to 20	1½ to 2½

potatoes, and peanuts can be grown on soils that otherwise would not be suitable for those crops. In most years, a greater amount of residue can be produced on soils that are irrigated, and more crops can be grown for cover and for green manure. A more flexible cropping system generally is possible on soils that are least subject to erosion because, under irrigation, these soils are suited to a wider range of crops. Better soil-improvement and fertility programs are also possible on the irrigated soils. The most practical way to maintain or improve fertility and to increase productivity is to return large amounts of residue to the soil.

IRRIGATED PASTURES.—The irrigation of pasture plants is important on dairy farms and other livestock farms. Many pastures deteriorate rapidly, mainly because of poor management.

Before planting a pasture that is to be irrigated, consult your county agent or local representative of the Soil Conservation Service for information on suitable species, time and method of planting, and the management needed to maintain productivity.

FERTILIZING.—Soil tests indicate that the irrigated soils in the county are low in organic matter, nitrogen, and phosphorus. The amount and kind of fertilizer used should be based on research, soil analyses, past cropping history, past fertilizing history, and production goals. Recommendations for one field may not be suitable for another field.

Representatives of the Soil Conservation Service and the county agricultural agents can assist farmers in planning fertilization programs.

Capability groups of irrigated soils

Only the capability classes, subclasses, and units for the irrigated soils in the county are described in the following list.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Unit IIe–1. Deep soils that have a medium-textured surface layer and a moderately permeable sandy clay loam subsoil.
  - Unit IIe–2. Deep soils that have a fine sandy loam surface layer and a moderately permeable sandy clay loam subsoil.
  - Unit IIe–3. Moderately deep soils that have a medium-textured surface layer and a moderately permeable subsoil.
  - Unit IIe–4. Deep and moderately deep soils that have a medium-textured surface layer and a slowly permeable subsoil.
  - Unit IIe–5. Moderately deep soils that have a medium-textured surface layer and a slowly permeable subsoil that is underlain by indurated caliche.
  - Unit IIe–9. Moderately deep soils that have a moderately coarse textured surface layer and a moderately permeable subsoil.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected. Wind erosion is the primary erosion hazard in Roosevelt County.
  - Unit IIIe–3. Deep soils that have a medium-textured surface layer and a moderately permeable sandy clay loam subsoil.
  - Unit IIIe–4. Deep soils that have a moderately coarse textured surface layer and a moderately permeable sandy clay loam subsoil.
  - Unit IIIe–6. Moderately deep soils that have a medium-textured surface layer and a moderately permeable or slowly permeable subsoil.
  - Unit IIIe–7. Moderately deep soils that have a moderately coarse textured surface layer and a moderately permeable subsoil.
  - Unit IIIe–10. Deep soils that have a coarse-textured surface layer and a moderately permeable sandy clay loam subsoil.
  - Unit IIIe–11. Deep soils that have a moderately fine textured surface layer and a strongly calcareous, slowly permeable subsoil.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected. Wind erosion is the primary erosion hazard in Roosevelt County.
  - Unit IVe–6. Moderately deep soils that have a coarse-textured surface layer and a moderately permeable sandy clay loam subsoil.
  - Unit IVe–7. Moderately deep, strongly calcareous, moderately permeable soils.
  - Unit IVe–8. Deep and moderately deep, moderately permeable or rapidly permeable soils.
  - Unit IVe–9. Shallow, strongly calcareous soils that have a soft, chalky substratum.
  - Unit IVe–11. Soils that have a coarse-textured surface layer and a strongly calcareous subsoil.
  - Unit IVe–12. Calcareous soils that have a medium-textured or moderately coarse textured surface layer and a moderately permeable subsoil.
  - Unit IVe–13. Shallow soils that have a medium-textured or moderately coarse textured surface layer and a thin subsoil that overlies hard caliche.

In the following pages, the soils of the county are arranged in capability units for irrigated farming. Each unit is described, and some suggestions for use and management are given.

CAPABILITY UNIT IIe–1 (IRRIGATED)

Amarillo loam, 0 to 1 percent slopes, is the only soil in this unit. This soil is deep, and it has a moderately permeable subsoil of sandy clay loam. The rate of water intake is moderate, and the water-holding capacity is high. A friable caliche layer occurs at a depth of 36 to 48 inches and limits the depth of the root zone.

If properly managed, this soil is only slightly susceptible to damage by wind. Good management includes efficient use of irrigation water, maintenance of a high level of fertility, and use of cover crops or crop residues suffi-

cient to control wind erosion. If crop residues are not adequate, emergency tillage will keep the surface rough and cloddy and thereby help to control soil blowing.

A crop that leaves a large amount of residue on the surface and that improves the soil needs to be grown 1 year in 3. If the cropping system does not include a high-residue crop, a mulch of suitable residues can be applied or a cover crop can be grown. Commercial fertilizer generally is needed to help maintain productivity.

This soil is suited to either surface or sprinkler irrigation. A properly designed irrigation system is needed for the efficient use of irrigation water.

CAPABILITY UNIT IIe-2 (IRRIGATED)

Amarillo fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. This soil has a moderate or rapid rate of water intake and is moderate or high in water-holding capacity. The depth of the effective root zone is 36 to 48 inches. The hazard of wind erosion on this soil is somewhat greater than on the medium-textured soil in capability unit IIe-1.

A crop that leaves a large amount of residue and that improves the soil should be grown 1 year in 3. If the cropping system does not include a high-residue crop, a mulch of suitable residues can be applied or a cover crop can be grown. Emergency tillage helps to control wind erosion if a protective cover is lacking. For favorable yields, use a properly designed irrigation system, fertilize according to the crop needs, plant good seed, control weeds, and use a crop rotation suited to the limitations of the soil. Both surface and sprinkler irrigation are suitable.

CAPABILITY UNIT IIe-3 (IRRIGATED)

The soils in this unit have a medium-textured surface layer and a moderately permeable subsoil. A layer of soft caliche occurs at a moderate depth and limits the depth of the effective root zone. The soils in this unit are—

Clovis loam, 0 to 1 percent slopes.
Olton-Zita loams, 0 to 1 percent slopes (Zita loam only).
Portales loam, 0 to 1 percent slopes.
Zita loam, 0 to 1 percent slopes.

The rate of water intake on these soils is moderate. The water-holding capacity is moderate or high and is slightly less than that of the soil in capability unit IIe-1.

If well managed, these soils are only slightly susceptible to erosion. Good management includes the efficient use of irrigation water, maintenance of soil fertility, and the use of crop residues or a cover crop to help control wind erosion.

A crop that leaves a large amount of residue on the surface and that improves the soil needs to be grown 1 year in 3. If the cropping system does not include a high-residue crop, a mulch of suitable residues can be applied or a cover crop can be grown. Emergency tillage to create a rough surface is a temporary measure that helps control soil blowing.

These soils are suited to either surface or sprinkler irrigation. To use irrigation water efficiently, a properly designed irrigation system is needed. In leveling, there may be some restrictions on the depth of cuts because of the moderate depth of the soils.

CAPABILITY UNIT IIe-4 (IRRIGATED)

This unit consists of deep and moderately deep soils that have a medium-textured surface layer and a slowly permeable clay loam subsoil. The soils in this unit are—

Olton loam, 0 to 1 percent slopes.
Olton-Zita loams, 0 to 1 percent slopes (Olton loam only).
Stegall loam, 0 to 1 percent.

The rate of water intake is slow or moderate on these soils, permeability is slow, and the water-holding capacity is moderate.

If well managed, these soils are only slightly susceptible to wind erosion. Good management includes the efficient use of irrigation water, maintenance of soil fertility, and the use of crop residues or a cover crop to help control wind erosion.

A crop that leaves a large amount of residue and that improves the soil needs to be grown 1 year in 3. If a high-residue crop is not grown, a mulch of other residues can be applied. Emergency tillage to create a rough surface is a temporary measure that helps to control soil blowing.

These soils are suited to either surface or sprinkler irrigation, but a well-designed irrigation system is needed for the efficient use of irrigation water. In leveling, the depth of the cuts may be somewhat limited because of the moderate depth of these soils.

CAPABILITY UNIT IIe-5 (IRRIGATED)

There is only one soil in this unit, Blackwater loam. This soil is moderately deep. The subsoil is slowly permeable and is underlain at a depth of about 20 inches by a layer of indurated caliche.

The rate of water intake on this soil is slow or moderate, permeability is slow, and the water-holding capacity is low or moderate. The hazard of erosion is slight. The heavy clayey subsoil restricts the movement of air and water and retards the growth of roots. Chiseling helps to break this compact layer, and the incorporation of organic matter into the tight subsoil is also helpful. This soil generally occurs in areas smaller than field size. It is suited to the same management as the soils in capability unit IIe-3.

A crop that leaves a large amount of residue on the surface and that improves the soil needs to be grown 1 year in 3. If a high-residue crop is not grown, a mulch of suitable residues can be used or a cover crop can be grown. Emergency tillage to create a rough surface is an effective temporary measure to help control wind erosion.

Surface irrigation is the best method of irrigating this soil. A well-planned irrigation system is needed for the efficient use of irrigation water. In leveling, the depth of the cuts may be limited because of the moderate depth of this soil.

CAPABILITY UNIT IIe-9 (IRRIGATED)

The soils in this unit have a moderately coarse textured surface layer and a moderately permeable subsoil. A layer of soft caliche occurs at a depth of 20 to 36 inches in all of these soils except the Arvana. In the Arvana soils, the caliche layer is indurated and rocklike. The soils in this unit are—

Arvana fine sandy loam, 0 to 1 percent slopes.
Clovis fine sandy loam, 0 to 1 percent slopes.
Portales fine sandy loam, 0 to 1 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

These soils have a moderate or rapid rate of water intake and are moderate in water-holding capacity. They are moderately susceptible to wind erosion.

Good management includes the efficient use of irrigation water, maintenance of soil fertility, and proper use of crop residues (fig. 20).

A high-residue crop needs to be grown about 1 year in 3. If the cropping system does not include a high-residue crop, a mulch of residues can be applied. Emergency tillage will create a rough surface and help to control wind erosion temporarily if a protective cover is lacking.

CAPABILITY UNIT IIIe-3 (IRRIGATED)

Amarillo loam, 1 to 3 percent slopes, is the only soil in this unit. It is deep, medium textured, and moderately permeable. A layer of soft caliche occurs below a depth of 36 inches.

This soil has a moderate rate of water intake and high water-holding capacity. It is slightly susceptible to wind erosion and moderately susceptible to water erosion.

The management needed includes the efficient use of irrigation water, maintenance of soil fertility, control of runoff, and the use of crop residues.

A high-residue crop needs to be grown every other year. If a level system of irrigation is installed, a high-residue crop, a soil-improvement crop, or a green-manure crop is needed only 1 year in 3.

Either surface or sprinkler irrigation is satisfactory on this gently sloping soil, but graded or level borders may be needed.

CAPABILITY UNIT IIIe-4 (IRRIGATED)

Amarillo fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This soil has a moderately coarse-textured surface layer and a moderately permeable subsoil. A layer of soft caliche, which occurs at a depth of about 48 inches, limits the depth of the root zone.

The rate of water intake is moderate, and the water-holding capacity is high. Moderate runoff can be expected. Susceptibility to wind erosion is slight or moderate.

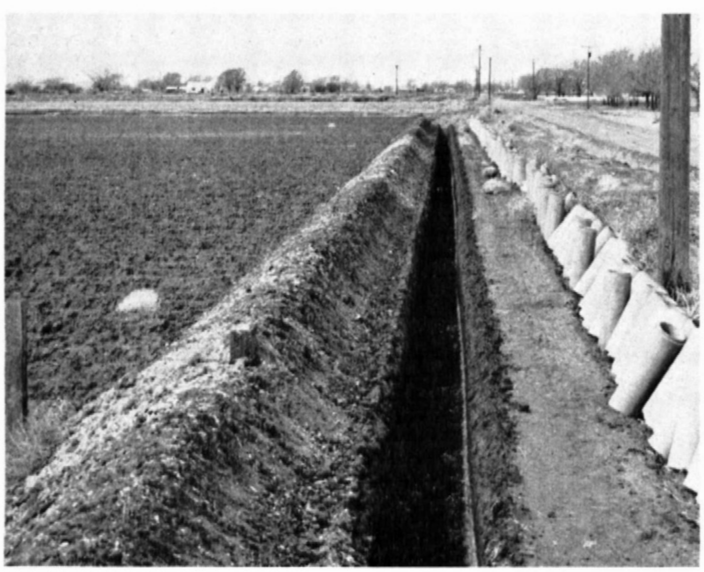

Figure 20.—**Installing pipeline on Clovis fine sandy loam.**

The management needed includes the efficient use of irrigation water, maintenance of soil fertility, control of runoff, and use of crop residues.

A crop that leaves a large amount of residue and one that improves the soil is needed every other year. If a high-residue crop is not grown, a mulch of suitable residues can be applied. A crop rotation that includes a high-residue crop only 1 year in 3 is suitable if a level system of irrigation is established.

This soil can be surface or sprinkler irrigated, but graded or level borders may be needed.

CAPABILITY UNIT IIIe-6 (IRRIGATED)

This unit consists of moderately deep, medium-textured, moderately permeable or slowly permeable soils on gentle slopes. The soils in this unit are—

Clovis loam, 1 to 3 percent slopes.
Mansker and Portales loams, 1 to 3 percent slopes (Portales loam only).
Stegall loam, 1 to 3 percent slopes.

Land leveling is essential if these soils are to be surface irrigated. Smooth grading is helpful if a sprinkler system is used.

If underground pipe is installed for irrigation, the indurated caliche, which occurs at a moderate depth in the Stegall soil, will limit the depth to which pipe can be placed in this soil or will impede its installation.

The cropping system needed is a high-residue crop 2 years in 4, and a soil-building crop every other year. However, if a level system of irrigation is installed, a high-residue crop is needed only 1 year in 3.

CAPABILITY UNIT IIIe-7 (IRRIGATED)

This unit consists of moderately deep soils that have a moderately coarse textured surface layer and a moderately permeable subsoil. The soils of this unit are—

Arvana fine sandy loam, 1 to 3 percent slopes.
Clovis fine sandy loam, 1 to 3 percent slopes.
Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Portales fine sandy loam only).

The rate of water intake on these soils is moderate, and the water-holding capacity is high. Runoff is moderate.

These soils are moderately susceptible to wind erosion. Emergency tillage to create a rough surface helps to control soil blowing.

Good management includes the efficient use of irrigation water, adequate use of commercial fertilizer, and proper use of crop residues to help control wind erosion. A high-residue crop needs to be grown about 2 years in 3, and a soil-improving crop, 1 year in 3 years. If a level system of irrigation is established, then a high-residue crop is needed only 1 year in 3.

These soils can be either surface or sprinkler irrigated. Graded or level borders may be needed on the stronger slopes.

CAPABILITY UNIT IIIe-10 (IRRIGATED)

The only soil in this unit is Amarillo loamy fine sand, 0 to 3 percent slopes. This soil is deep, and it has a coarse-textured surface layer and a moderately permeable subsoil of sandy clay loam.

Runoff is slow, the rate of water intake is rapid and the water-holding capacity is low or moderate. Susceptibility to wind erosion is high.

796-738—67——3

Good management includes the use of residues on the surface in amounts sufficient to control soil blowing, the application of commercial fertilizer to meet the needs of the crop, and tillage to create a rough surface.

A high-residue crop needs to be grown 2 years in 3. If protective residue is lacking, emergency tillage creates a rough surface and helps to prevent soil blowing. Deep plowing is a temporary measure to help resist wind erosion.

Sprinkler irrigation is best suited to this sandy soil.

CAPABILITY UNIT IIIe-11 (IRRIGATED)

The only soil in this unit is Church clay loam. This soil is deep, calcareous, and slowly permeable. The stability of the surface layer is low because of the high content of lime. Thus susceptibility to wind erosion is high.

Water enters the surface layer at a moderate or slow rate, but the initial rate of water intake may be high if there are cracks in the surface layer. The water-holding capacity is high, but moisture is slowly available to crops.

To help control wind erosion and to improve the soil, high-residue crops need to be grown 2 years in 3. If the amount of residue is low, additional organic matter can be supplied by a good mulch, such as manure. If bare, these soils can be chiseled to create a rough, cloddy surface, but emergency tillage is only a temporary measure to help control soil blowing.

Surface irrigation is the best method of applying water to this soil.

CAPABILITY UNIT IVe-6 (IRRIGATED)

The soils of this unit are moderately deep. They have a coarse-textured surface layer and a moderately permeable subsoil of sandy clay loam. The soils of this unit are—

Arvana loamy fine sand, 0 to 3 percent slopes.
Clovis loamy fine sand, 0 to 3 percent slopes.

The rate of water intake on these soils is high, the water-holding capacity is low or moderate, and runoff is low. The hazard of wind erosion is serious.

Growing high-residue crops 2 years in 3 and leaving a large amount of residue or mulch on these sandy soils will help to control erosion. Emergency listing will temporarily control soil blowing if the residue is not sufficient or surface mulch is lacking.

These soils can be surface irrigated if they are properly leveled and a designed irrigation system is installed. Otherwise, they are suited only to sprinkler irrigation.

CAPABILITY UNIT IVe-7 (IRRIGATED)

The soils of this unit are moderately deep and moderately permeable. The substratum is strongly calcareous. The soils in this unit are—

Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Mansker fine sandy loam only).
Mansker and Portales loams, 1 to 3 percent slopes (Mansker loam only).

These soils are calcareous throughout and thus are susceptible to wind erosion. The rate of water intake is moderate, and the water-holding capacity is low or moderate. Lime-induced chlorosis, or yellowing of plant leaves, is common on these soils.

Following are some measures that help to control wind erosion and to conserve moisture: Leave an adequate amount of crop residue on the surface; leave stubble 12 to 14 inches high on land used for row crops; limit grazing to allow adequate growth of the plant cover; apply manure or plow under green manure as a soil-improvement practice; apply commercial fertilizer according to crop needs; use emergency tillage if necessary; and use an irrigation system designed for the efficient use of water. Plant only good seed, and control weeds.

These soils can be bench leveled and surface irrigated. Sprinkler irrigation is also suitable.

CAPABILITY UNIT IVe-8 (IRRIGATED)

This unit consists of deep and moderately deep soils that have a moderately permeable or rapidly permeable subsoil. The soils in this unit are—

Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded.
Springer loamy fine sand.

In places the surface layer of the Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded, has been severely altered by wind erosion.

The soils of this unit are low or moderate in water-holding capacity. They are highly susceptible to wind erosion. Good management practices include fertilizing to meet the needs of the crop, mulching, and returning crop residues to the soil. A high-residue crop needs to be grown each year.

These soils are best suited to sprinkler irrigation.

CAPABILITY UNIT IVe-9 (IRRIGATED)

The soils in this unit are shallow. They are underlain at a depth of less than 1 foot by a soft, chalky lime zone. The soils of this unit are—

Arch loam.
Arch fine sandy loam.
Tivoli-Arch complex (Arch soil only).

Certain crops, particularly peanuts, are affected by lime-induced chlorosis if grown on these soils. The rate of water intake is moderate or high, and the water-holding capacity is low.

If these soils are leveled, the chalky lime layer may be exposed. In such areas, generous applications of manure help to improve fertility and to increase productivity.

Conservation practices needed to control erosion include returning a large amount of residue to these soils, leaving stubble 12 to 14 inches high, and restricting grazing. A high-residue crop needs to be grown 2 years in 3.

These soils are suitable for both surface and sprinkler irrigation. In order to use irrigation water efficiently, a properly designed irrigation system needs to be installed.

CAPABILITY UNIT IVe-11 (IRRIGATED)

The soils in this unit have a coarse-textured surface layer and a strongly calcareous subsoil. They are—

Arch loamy fine sand.
Gomez loamy fine sand.

The rate of water intake is high on these soils, and the water-holding capacity is low. Soft, chalky caliche, which begins at a depth of about 12 to 24 inches, restricts the growth of roots.

These soils are highly susceptible to wind erosion. The management needed for continued production includes leaving an abundance of residue on the surface or adding manure or mulch, and applying fertilizer in amounts sufficient to meet the crop needs. A closely spaced, high-resi-

due crop needs to be grown each year, or a soil-improving crop, 2 years in 3.

Sprinkler irrigation is the best method of applying water to these calcareous sandy soils.

CAPABILITY UNIT IVe-12 (IRRIGATED)

This unit is made up of Drake soils. These soils are gently sloping or sloping and are calcareous throughout. The surface layer ranges from loam to fine sandy loam.

These soils are moderately or highly susceptible to wind erosion. Runoff is moderate, and the rate of water intake and the permeability are moderate. Little of the acreage is farmed, but in areas that are cultivated careful management is needed to keep these soils productive.

These soils respond favorably to intensive soil-improving practices. Because of the erosion hazard, a high-residue crop needs to be grown each year, and the residues returned to the soil. If a high-residue, closely spaced crop is not grown, it is desirable to grow a soil-improving crop half the time. Commercial fertilizer is needed in addition to annual applications of manure. Smooth grading or benching is desirable for the efficient application of irrigation water.

CAPABILITY UNIT IVe-13 (IRRIGATED)

The soils of this unit are shallow over hard caliche. They have a medium-textured or moderately coarse textured surface layer and a moderately permeable subsoil. The soils of this unit are—

Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
Stegall loam, shallow, 0 to 1 percent slopes.

The water-holding capacity is low, and the rate of water intake is moderate. Wind erosion is a moderate hazard.

These soils need to be kept in a high-residue crop all of the time or in a soil-improving crop half of the time. They will be less difficult to manage if the caliche rocks are removed as they are exposed in plowing.

Surface irrigation is the best method of applying water to these soils. The layer of hard caliche limits the depth to which cuts can be made for land leveling, but in most places the soils are smooth and level, and this treatment is not needed. In other places the sprinkler system can be used to advantage.

Estimated yields of irrigated crops

Table 4 shows estimated average acre yields of crops on selected soils under irrigation in Roosevelt County. The data are given for two levels of management. In columns A are yields to be expected under ordinary management. This management neglects one or more important practices required to obtain the yields shown in columns B. The yields shown in columns B can be expected under good management that includes a planned crop rotation for soil improvement, a balanced fertilizer program to meet the needs of the crop grown, the use of good seed, the control of weeds, and the efficient use of irrigation water.

The estimated yields of cotton and peanuts were based on records of agricultural programs. Those of cotton were checked with records kept by cotton gins. Yields of other crops were obtained from reports of experiment stations and from selected farm records. All data are from planted acres.

Range Management [2]

The proper use of the grasslands is essential to the economy of the county. Native grassland makes up about 1,108,000 acres, or more than 70 percent of the agricultural land. Most of this acreage is used to graze livestock, principally cattle.

It is estimated that of the above acreage about 107,000 acres should be reseeded to native grasses. Part of this acreage is cropland that has been abandoned. In some fields that have been out of cultivation for many years, the plant cover consists mainly of low-value grasses and perennial weeds. The competition of these plants for the limited supply of moisture prevents the satisfactory restoration of native grass seedlings. Successful reseeding of these sites requires the elimination of the low-value plants and the establishment of an annual cover crop such as sudangrass or forage sorghum.

Range seeding generally is suitable for all soils in the county, except those in the Gravelly Upland range site and those in the Shallow Upland range site.

The information in this subsection can be used to evaluate the present condition of a range site and to estimate the potential production of a site.

Principles of range management

Sound range management requires that the number of livestock and periods of grazing be adjusted so that the best native forage plants have a chance to grow. Experience has shown that when not more than about half of the yearly volume of key forage plants are grazed, these better plants are able to maintain their growth and vigor. Forage that is left on the range has the following values—

1. Serves as a mulch that encourages more rapid intake of water. Thus, more water is stored in the soil to encourage plant growth.
2. Insulates the soil against extremes in temperature and slows evaporation. Thus, moisture is conserved for plants to use.
3. Holds more of the snow where it falls.
4. Protects the soil from wind and water erosion.
5. Provides a reserve of forage for poor years and a reserve of food in the roots for rapid response to favorable growing conditions.
6. Helps to maintain fertility and to preserve soil structure through its decay and return to the soil.
7. Provides a favorable seedbed for seedlings.
8. Allows the plant to develop a good root system.

Range sites and condition classes

To achieve the best yields of range forage, ranchers need to know about the soils of their holdings and the kinds of plants these soils are capable of producing.

Range sites are areas of rangeland that differ from each other in their ability to produce significantly different kinds and amounts of vegetation. Each range site produces a distinctive association of plants referred to as the climax vegetation. *Climax vegetation* is the stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment remains

[2] This subsection was prepared by E. W. WILLIAMS and DANIEL L. MERKEL, range conservationists, Soil Conservation Service.

TABLE 4.—*Estimated average acre yields of crops on the principal irrigated soils under two levels of management*

[Yields in columns A are those obtained under common management; yields in columns B are those obtained under improved management; absence of yield indicates crop is not generally grown on the soil at the level of management specified]

Soil	Cotton (lint)		Peanuts		Grain sorghum		Sweetpotatoes	
	A	B	A	B	A	B	A	B
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Bu.*	*Bu.*
Amarillo loamy fine sand, 0 to 3 percent slopes	425	600	1,050	1,800	3,500	4,500	650	800
Amarillo fine sandy loam, 0 to 1 percent slopes	550	800	1,650	2,400	4,000	5,600	900	950
Amarillo fine sandy loam, 1 to 3 percent slopes	500	750	1,600	2,200	4,000	5,200	850	950
Amarillo loam, 0 to 1 percent slopes	600	900	1,750	2,400	4,800	7,500	800	950
Amarillo loam, 1 to 3 percent slopes	575	875	1,700	2,200	4,500	7,200	750	900
Arch fine sandy loam	350	500	800	1,000	2,200	2,800	300	500
Arch loam	350	500	900	1,600	2,200	2,800	300	500
Arvana loamy fine sand, 0 to 3 percent slopes	400	550	1,050	1,750	3,000	4,000	650	800
Arvana fine sandy loam, 0 to 1 percent slopes	500	700	1,600	2,000	3,800	5,000	850	950
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	450	650	1,500	1,800	3,600	4,500	------	------
Blackwater loam	450	750	1,000	1,500	4,200	7,000	------	------
Clovis loamy fine sand, 0 to 3 percent slopes	425	600	1,000	1,700	3,500	4,500	650	750
Clovis fine sandy loam, 0 to 1 percent slopes	550	800	1,600	2,200	4,000	5,600	750	850
Clovis fine sandy loam, 1 to 3 percent slopes	550	775	1,600	2,200	4,000	5,200	725	800
Clovis loam, 0 to 1 percent slopes	550	800	1,600	2,200	4,800	7,500	700	800
Clovis loam, 1 to 3 percent slopes	500	775	1,500	2,000	4,200	7,000	650	775
Gomez loamy fine sand	------	------	------	------	2,200	2,800	------	------
Mansker and Portales fine sandy loams, 1 to 3 percent slopes:								
Mansker fine sandy loam	350	500	1,150	1,700	2,800	3,600	300	500
Portales fine sandy loam	450	600	1,300	2,000	4,000	4,800	750	850
Mansker and Portales loams, 1 to 3 percent slopes:								
Mansker loam	425	550	1,400	2,000	4,000	5,000	300	500
Portales loam	450	650	1,500	2,000	4,000	6,500	650	750
Olton loam, 0 to 1 percent slopes	600	800	1,800	2,400	4,000	7,000	700	850
Portales fine sandy loam, 0 to 1 percent slopes	450	600	1,500	2,000	3,800	5,000	700	800
Portales loam, 0 to 1 percent slopes	500	700	1,500	2,200	4,200	7,200	650	750
Springer loamy fine sand	------	------	------	------	3,000	4,000	400	550
Stegall loam, 0 to 1 percent slopes	550	800	1,750	2,200	4,500	7,000	700	850
Stegall loam, 1 to 3 percent slopes	500	750	1,600	2,000	4,000	6,500	650	800
Stegall loam, shallow, 0 to 1 percent slopes	400	500	1,200	1,800	3,800	5,000	------	------
Zita fine sandy loam, 0 to 1 percent slopes	550	800	1,600	2,200	4,000	5,200	750	800
Zita loam, 0 to 1 percent slopes	550	800	1,600	2,200	4,500	7,000	675	750

unchanged. It consists of plants that were growing there before the range was used by domestic livestock. The climax vegetation in Roosevelt County is mostly perennial grasses.

Under improper or excessive grazing, the site may change to a different and perhaps less desirable type of vegetation. This condition develops because livestock graze selectively, seeking first the most palatable and nutritious plants. If grazing is not carefully regulated, the most palatable plants eventually are eliminated and are replaced by plants that are less palatable. If excessive grazing continues, these plants will be replaced by more undesirable and weedy species.

Range plants have, therefore, been classified in three broad categories, based on their response to grazing. Plants that die out or diminish in number under poor management are called *decreasers.* Plants that increase in abundance as the more desirable plants are reduced by continued heavy grazing are called *increasers.* These plants commonly are shorter, less productive, and less palatable to livestock than the decreasers. Plants that normally do not grow on the specific site are called *invaders.* They generally are weedy plants that are able to become established only after the more desirable vegetation is weakened or destroyed by poor grazing management, drought, or soil disturbance.

The percentage of climax vegetation on a site is used to determine *range condition.* Range condition classes indicate how much the present plant community has departed from the potential or climax plant community. A range is in *excellent condition* if 76 to 100 percent of the vegetation is of the same kind as the original stand. It is in *good condition* if the percentage is between 51 and 75 percent, in *fair condition* if the percentage is between 26 and 50, and in *poor condition* if the percentage is less than 25. The determination of range condition provides a basis for the management of the site.

Descriptions of range sites

Each range site in the county is briefly described in the following pages. This description lists the soils in each site, gives the potential, or climax, plant community that the site will support, and shows the yields that can be expected if the site is in excellent condition. Production is expressed in air-dry pounds per acre of the total annual growth of all plants on a range site. This yield includes plants that have no value for domestic livestock. Riverwash, a miscellaneous land type, is not shown in a range site.

LOAMY UPLAND RANGE SITE

This site is made up of deep or moderately deep loams that have a slope range of 0 to 3 percent. The rate of

water intake is moderate, and the water-holding capacity is medium or high. The soils in this site are—

Amarillo loam, 0 to 1 percent slopes.
Amarillo loam, 1 to 3 percent slopes.
Blackwater loam.
Clovis loam, 0 to 1 percent slopes.
Clovis loam, 1 to 3 percent slopes.
Mansker and Portales loams, 1 to 3 percent slopes (Portales loam only).
Olton loam, 0 to 1 percent slopes.
Olton-Zita loams, 0 to 1 percent slopes.
Portales loam, 0 to 1 percent slopes.
Stegall loam, 0 to 1 percent slopes.
Stegall loam, 1 to 3 percent slopes.
Stegall loam, shallow, 0 to 1 percent slopes.
Zita loam, 0 to 1 percent slopes.

If the range is in good or excellent condition, blue grama makes up about 60 percent of the plant cover. Other grasses are buffalograss, sideoats grama, black grama, and tobosa. On sites that are overgrazed, the cover changes to a low sodlike growth of blue grama and buffalograss and includes some patches of tobosa and ring muhly. In these areas black grama, sideoats grama, vine-mesquite, and western wheatgrass commonly are lacking. In years of more than normal rainfall, a heavy growth of broom snakeweed may become established and persist for several years.

If the range is in excellent condition, the total growth of all plants is 1,600 pounds, air-dry weight.

LIMY UPLAND RANGE SITE

Soils of this site occur throughout the county, commonly on the leeward side of intermittent lakes (fig. 21). In places they are at slightly higher elevations than that of the surrounding plain. These soils are limy throughout and, if not protected by vegetation, are susceptible to wind erosion. The soils in this site are—

Arch fine sandy loam.
Arch loam.
Arch soils, severely eroded.
Drake soils.
Mansker and Portales loams, 1 to 3 percent slopes (Mansker soil only).
Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Mansker soil only).
Tivoli-Arch complex (Arch soil only).

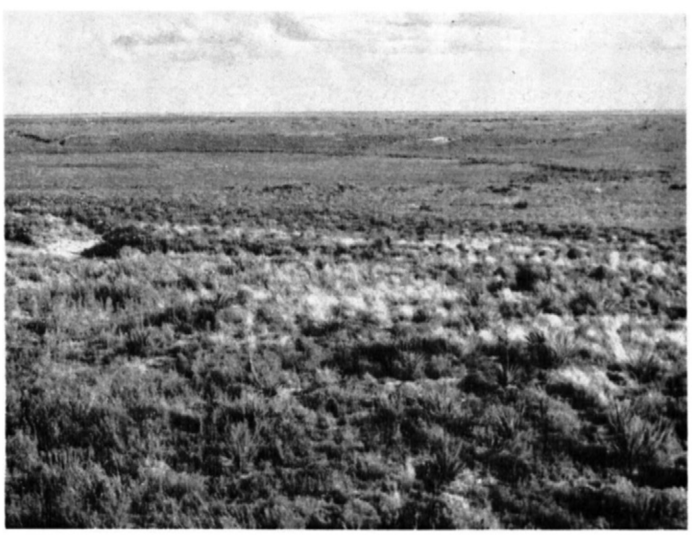

Figure 21.—**Limy Upland range site.**

Sideoats grama is the dominant grass in the climax vegetation. Associated grasses are alkali sacaton, little bluestem, black grama, silver bluestem, blue grama, and hairy grama. Woody plants associated with these grasses are fourwing saltbush and small soapweed. If the site is heavily grazed, little bluestem and black grama may disappear, sideoats grama generally persists but is reduced in vigor, and buffalograss may become dominant in the plant composition. Three-awn and broom snakeweed are active invaders.

If in excellent condition, this site is productive. Production decreases rapidly as the mid grasses are reduced in vigor and abundance.

If the range is in excellent condition, the total growth of all plants is 1,800 pounds, air-dry weight.

SALT FLATS RANGE SITE

This site consists of nearly level, poorly drained, fine-textured soils that surround the lower basins of playas. These soils generally contain a considerable amount of salt. Internal drainage is poor, and the water table frequently is high. The site is occasionally covered by water when the playa receives more than an average amount of runoff. The soils in this site are—

Church clay loam.
Church soils, severely eroded.

Alkali sacaton is dominant in most areas, but there are also considerable amounts of western wheatgrass and small amounts of inland saltgrass and alkali muhly. Fourwing saltbush occurs in places along the upper margin of this site. If this site is heavily grazed, the alkali sacaton, western wheatgrass, and fourwing saltbush decrease, and almost pure stands of inland saltgrass may become dominant.

This site is highly productive if it is in good or excellent condition. If it is reduced to poor or fair condition, production is greatly decreased because there are few plants of intermediate value.

If the range is in excellent condition, the total growth of all plants is 2,500 pounds, air-dry weight.

GRAVELLY UPLAND RANGE SITE

This site is made up of Hilly gravelly land on low, rounded ridges and hills or near the bottom of strong slopes. Waterworn gravel, as large as 4 inches in diameter, occurs throughout the soil material, and there are some scattered boulders. The rate of water intake is rapid, and the water-holding capacity is low.

If the range is in good or excellent condition, the plant cover is made up principally of black grama, sideoats grama, and blue grama and of smaller amounts of little bluestem and New Mexican feathergrass. About 5 to 10 percent of the plant cover may consist of such woody plants as catclaw mimosa, feather dalea, Apache-plume, squawbush, and littleleaf sumac. As the range deteriorates, black grama, sideoats grama, little bluestem, and New Mexican feathergrass decrease, and blue grama, hairy tridens, rough tridens, and three-awn increase.

If the range is in excellent condition, the total growth of all plants is 1,500 pounds, air-dry weight.

LOAMY BOTTOMLAND RANGE SITE

The Bippus and Spur soils are the only soils in this site. These soils occur in low-lying areas where rainfall accumulates in quantities sufficient to flood the vegetation.

The climax vegetation consists mostly of sideoats grama, vine-mesquite, Wrights sacaton, and blue grama. Under continued poor management, the site deteriorates, and buffalograss, galleta, and mat muhly become dominant.

If the range is in excellent condition, the total growth of all plants is 2,500 pounds, air-dry weight.

SANDY PLAINS RANGE SITE

The soils in this site are nearly level to undulating and in most places are more than 20 inches thick (fig. 22). They have a fine sand or loamy fine sand surface layer and a medium-textured loamy subsoil. The rate of water intake is rapid, and the water-holding capacity is good. The soils in this site are—

Arch loamy fine sand.
Brownfield fine sand.
Gomez loamy fine sand.
Springer loamy fine sand.
Springer soils, severely eroded.

If the range is in good or excellent range condition, the vegetation consists principally of tall and mid grasses.

Figure 22.—**Sandy Plains range site in good condition. This site is susceptible to severe erosion if not protected by an adequate amount of residue.**

The most abundant grasses are little bluestem, sideoats grama, and sand bluestem. Other grasses are yellow indiangrass, switchgrass, New Mexico feathergrass, needle-and-thread, sand dropseed, black grama, and hairy grama. Sand sagebrush, small soapweed, and shinnery oak are also common on this site. Overgrazing for a period of years results in a decrease of the better mid and tall grasses and an increase of sand sagebrush, shinnery oak, small soapweed, three-awn, red lovegrass, tumble lovegrass, and sand dropseed.

If the range is in poor condition, the plant cover may consist mostly of woody species and annual and perennial weeds. At this point, wind erosion becomes a serious problem, and sand dunes may form. Dune stabilization, either by revegetation or by mechanical means, may be necessary in places to control the surface movement of sand dunes or the shifting of sand.

If the range is in excellent condition, the total growth of all plants is 2,200 pounds, air-dry weight.

VALLEY CLAY RANGE SITE

This site consists of only one soil, Montoya clay loam, which occurs on side slopes and in swales. This is a deep, nearly level or gently sloping soil that developed in red-bed alluvium. It takes water slowly but has high water-holding capacity. In places, the subsoil contains some salts or alkali.

If the range is in good or excellent condition, the main vegetation is alkali sacaton, western wheatgrass, vine-mesquite, tobosa, switchgrass, blue grama and, in places, some fourwing saltbush. Under continued heavy grazing, alkali sacaton, western wheatgrass, vine-mesquite, and switchgrass decrease or disappear entirely, and tobosa, an aggressive increaser, becomes dominant. Blue grama, buffalograss, mat muhly, inland saltgrass, and burrograss may make up a minor part of the vegetation. Mesquite invades the valley areas, and in places a heavy growth may become established.

If the range is in excellent condition, the total growth of all plants is 3,000 pounds, air-dry weight.

SANDY UPLAND RANGE SITE

This site consists of nearly level or gently undulating soils that have a coarse-textured or moderately coarse textured surface layer and a medium-textured subsoil. These soils have a rapid rate of water intake and high water-holding capacity. The soils in this site are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.
Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded.
Arvana loamy fine sand, 0 to 3 percent slopes.
Arvana loamy fine sand, shallow, 0 to 1 percent slopes.
Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
Berthoud sandy loam, 2 to 9 percent slopes.
Clovis loamy fine sand, 0 to 3 percent slopes.
Clovis fine sandy loam, 0 to 1 percent slopes.
Clovis fine sandy loam, 1 to 3 percent slopes.
Mansker and Portales fine sandy loams, 1 to 3 percent slopes (Portales soil only).
Portales fine sandy loam, 0 to 1 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

The climax vegetation consists mainly of a mixture of mid and short grasses. On most sites, little bluestem,

sideoats grama, black grama, blue grama, and bush muhly are the most common species, but in the southern and southwestern parts of the county, black grama generally is dominant. Under continued grazing, the better mid grasses are eliminated, and a close turf of blue grama, hairy grama, and buffalograss develops. Three-awn, small soapweed, and woody species may invade if the site is in poor condition.

If the range is in excellent condition, the total growth of all plants is 2,000 pounds, air-dry weight.

DEEP SAND RANGE SITE

This site consists of deep, loose sands. The surface ranges from smooth to dunelike. The soils take water rapidly and have low water-holding capacity. In this area of limited rainfall, soil moisture conditions are favorable for plant growth because most of the moisture received enters the soil, and a high percentage of this water is available for plants to use. The soils in this site are—

Blown-out and dune land.
Brownfield soils, severely eroded.
Tivoli fine sand.
Tivoli-Arch complex (Tivoli soil only).

If the site is in good or excellent condition, the plant cover is made up mainly of tall and mid grasses. The most common tall grasses are sand bluestem, yellow indiangrass, sandreed, switchgrass, and giant dropseed. The most common mid grasses are little bluestem and sideoats grama. In the climax vegetation, there may be a small amount of shinnery oak, sand sagebrush, small soapweed, sandplum, squawbush, littleleaf sumac, and Mormon-tea.

If the range is closely grazed, the tall grasses decrease and may disappear entirely. Their place is then taken by shorter grasses or more unpalatable plants such as sand dropseed, three-awn, and tumble lovegrass. There will also be an increased amount of shinnery oak, sand sagebrush, small soapweed, queen's-delight, and weeds (fig. 23).

If the vegetation on this site is destroyed by overgrazing or by cultivation, bare sand dunes may develop. Consequently, in the management of this site, care should be taken to leave enough stubble and plant residues on the surface at all times to prevent damage by wind. If bare sand dunes develop, dune stabilization often is necessary to control the surface movement of sand. This may be done either by mechanical means or by revegetation.

This site is highly productive if it is in excellent or good condition. If in fair or poor condition, it is much less productive because the tall grasses are replaced by short species.

If the range is in excellent condition, the total growth of all plants is 2,300 pounds, air-dry weight.

SHALLOW UPLAND RANGE SITE

Soils of this site occur throughout the county, mostly adjacent to or intermingled with soils of the Loamy Upland range site. They consist of shallow, medium-textured or coarse-textured soils on ridges, on side slopes and upper margins of large drainageways, and on slopes surrounding playas (fig. 24). The soils of this site are—

Arvana soils, 0 to 3 percent slopes, severely eroded.
Kimbrough fine sandy loam.
Kimbrough loam.
Potter soils, 0 to 9 percent slopes.
Rough broken land.
Travessilla loam.

The climax vegetation of this site is a mixture of mid and short grasses, shrubs, and palatable forbs. The principal grasses are sideoats grama, little bluestem, New Mexico feathergrass, silver bluestem, wolftail, blue grama, black grama, and hairy grama. The common shrubs are feather peabush, fragrant mimosa, catclaw mimosa, bigelow sagebrush, small soapweed, squawbush, and several species of cactus. Fringed sage, broom snakeweed, stemless pingue, and several kinds of wild buckwheat also occur in the plant cover.

If the site is in poor or fair condition, New Mexico

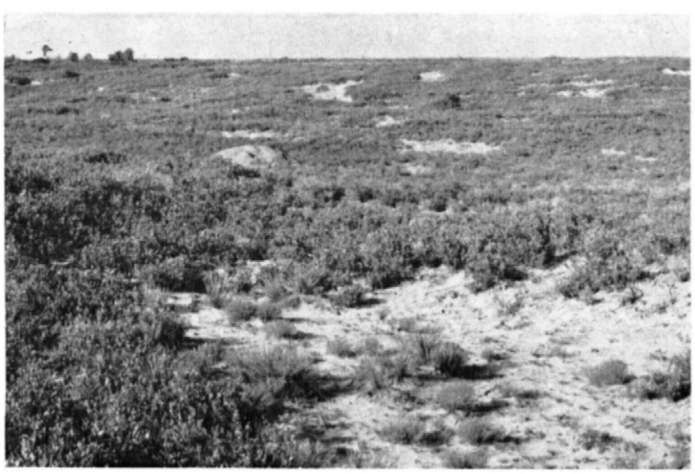

Figure 23.—Deep Sand range site in poor condition. Shinnery oak is dominant in the plant cover.

Figure 24.—Shallow Upland range site.

feathergrass and little bluestem are scarce or lacking. Sideoats grama commonly persists but lacks height and vigor. The mid grasses are replaced by blue grama and hairy grama and by such undesirable plants as three-awn, hairy tridens, and ring muhly. A site in poor condition generally has a heavy stand of broom snakeweed and smaller amounts of stemless pingue, fringed sage, and catclaw acacia.

If the range is in excellent condition, the total growth of all plants is 1,600 pounds, air-dry weight.

Wildlife[3]

Before the settlement of Roosevelt County by ranchers and homesteaders, the area was inhabited by large populations of American bison, pronghorn antelope, and white-tailed deer. The bison were practically exterminated by hide hunters during the early 1880's, and the pronghorn antelope were virtually extinct by 1920. Since 1920, under the protection of the State Game Department, the pronghorn antelope have repopulated most of the rangelands of the county. The white-tailed deer could not withstand the hunting pressure and land changes, and they did not respond to protection. Consequently, there probably are less than a hundred of these deer in New Mexico, and their present range includes only a small part of Roosevelt County, south of Kenna.

Formerly, the black-tailed prairie dog was one of the more common small mammals in the county. This burrowing animal was most numerous in areas where the soils are loams or clay loams. These stable soils are favorable for their burrows and support short grasses that afford unobstructed vision. These animals because of their sedentary habits were easily poisoned, and now only a few colonies remain.

Pocket gophers are common both in cultivated areas and on rangelands. They are a pest in irrigated hay fields because their mounds cause trouble in mowing and the roots of alfalfa are a favorite food. Their burrows in irrigation ditches and borders often cause washouts or failure in the irrigation system. The number of gophers on rangelands seldom is sufficient to have any significant effect on forage yields.

Several species of kangaroo rats and pocket mice are indigenous to the county. They are particularly numerous on sandy range sites and, because of their feeding habits, are often a limiting factor in the reseeding or natural recovery of depleted range. They have little obvious effect on forage production if the range is in good or excellent condition.

Rabbits are common throughout the county. The most abundant is the plains jackrabbit, which often becomes a pest on farm and ranch lands. Cottontail rabbits are also common throughout the county but seldom reach a population that is troublesome.

The sandy soils of the county are particularly well suited as habitats for game birds. Because of the favorable soil-moisture relationship, these soils are productive of tall and mid grasses as well as associated shrubs and weeds. This kind of vegetation provides protective cover and an abundant and varied food supply for game birds.

[3] This subsection was prepared by JOHN FARLEY, wildlife biologist, Soil Conservation Service.

***Figure 25.*—Male and female Lesser prairie chickens on the booming ground, Roosevelt County. (Photo by New Mexico Dept. of Game and Fish.)**

Roosevelt County and parts of adjoining counties are the only areas in the State populated by the Lesser prairie chicken. This bird breeds in areas commonly referred to as the sandhills (fig. 25). Its yearlong range includes the moderately deep sandy soils on which most of the dry-farmed row crops are grown.

Scaled quail, also called blue quail, inhabits nearly all areas of the county. The scaled quail offers hunters the largest game-bird harvest in the county and, except during periods of cyclic lows, hunter success is good.

The mourning dove is one of the most common migratory birds in the county. In fall it affords excellent hunting. During wet periods, when the intermittent lakes are filled with water, numerous ducks and some geese are attracted to the area. The county is also one of the preferred wintering areas for the sandhill crane, and flocks of several hundred are common during the winter months.

Lack of adequate food and cover limits the number of game birds in the county. Proper land use and land treatment in a soil conservation program provide an environment favorable for wildlife. Native forage and residues left for soil protection make suitable habitats. A good stand of tall and mid grasses on rangeland provides shelter and nesting cover as well as food. The production of cultivated crops, particularly grain sorghum, has improved the food supply in the county for quail and prairie chickens.

Soils in Engineering[4]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, building foundations, pipelines, drainage systems, facilities for water storage, erosion control structures, sewage disposal systems, irrigation systems, and

[4] By LUTHER F. MCDOUGAL, area engineer, Soil Conservation Service.

other related structures. The soil properties most important to engineers are permeability, sheer strength, compaction, shrink-swell characteristics, water-holding capacity, grain size, plasticity, and soil reaction. Also important are topography, depth to bedrock or caliche, and depth to the water table.

The characteristics of the soils in Roosevelt County are described in detail in the section "Description of the Soils." Those characteristics that affect engineering are interpreted in this section, which is for engineers and others concerned with use of soil material in construction.

It should be emphasized that the engineering interpretations reported here may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where excavations are deeper than the depth of the layers here reported. Even in these situations, however, the soil map at the back of this report is useful in planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

The information in this section can be used to—

1. Make preliminary estimates of the soil properties that are important in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
3. Locate probable sources of sand, gravel, and construction material.
4. Make soil and land-use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
5. Supplement the information obtained from other published maps, reports, or aerial photographs for the purpose of making maps and reports that can be readily used by engineers.
6. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Some of the terms used by soil scientists may not be familiar to engineers, and some words may have special meanings in soil science. Most of these terms, as well as other special terms that are used in the soil survey report, are defined in the Glossary at the back of this report.

Engineering classification systems

In this section, soil texture is described according to the classification used by the U.S. Department of Agriculture, the system used by the American Association of State Highway Officials (AASHO) (*1*), and the United system developed by the Corps of Engineers, U.S. Army (*12*).

In the system used by scientists of the U.S. Department of Agriculture, the texture of the soil horizon depends on the proportional amounts of the different sized mineral particles. The percentage of soil material smaller than 2.0 millimeters (classified as clay, silt, and sand) determines the textural classification.

The AASHO system classifies the soils according to their engineering properties, based on field performance of highways. In this system soil materials are classified in seven basic groups, designated A–1 through A–7. The best soils for road subgrades—gravelly soils of high bearing capacity—are classified as A–1; the next best, A–2; and so on to the poorest, which are classified as A–7.

The Unified system is based on the identification of soils according to particle size, plasticity, and liquid limit. In the Unified system SW and SP are clean sands; SM and SC are sands with nonplastic or plastic fines (G will replace S for soils if the major coarse fraction is gravel); ML and CL are nonplastic or plastic fine-grained materials with low liquid limits; and MH and CH are primarily nonplastic or plastic fine-grained materials with high liquid limit. If soils are on the border line between two classifications, a joint classification symbol is used, for example, ML–CL.

Estimated engineering properties

Table 5 gives a brief description of the soils of Roosevelt County and estimates of some of the physical and chemical properties that affect engineering work. Information taken from the soil survey, knowledge of the individual soils of the county, and the test data shown in table 7 were used as a basis for describing the soils and estimating their properties.

The three columns in table 5, under the heading "Classification," define soil texture as it is classed by soil scientists and by engineers.

The estimated percentage of soil material passing sieves No. 4, No. 10, and No. 200 reflects the normal range for a soil series. Most soils will fall within the range given. However, the grain size of any soil varies considerably. It should not be assumed, therefore, that all samples of a specific soil will fall within the range shown, nor that the engineering classification will invariably be as shown.

The rates of permeability given in table 5 are based on the movement of water through the soil in its undisturbed state. The rates depend largely on the texture and structure of the soil.

Available moisture capacity, measured in inches per inch of soil depth, is the approximate amount of capillary water in the soil at field capacity. When the soil is air dry, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Reaction refers to the degree of acidity or alkalinity of a soil, expressed in pH values. A soil having a pH value of 7 is considered to be neutral. Soils in Roosevelt County are either neutral or alkaline.

Shrink-swell potential is an indication of the volume change to be expected with a change in moisture content. In general, soils classified as CH and A–7 have a high shrink-swell potential. Clean sand and gravel (single grain material) and most other nonplastic or slightly plastic soils have a low shrink-swell potential.

Engineering interpretations

Table 6 gives estimates of the suitability of the soils of the county for specified engineering uses and lists the soil properties that might present hazards or difficulties for such use.

Soils are rated poor or fair as a source of topsoil if they are eroded, are low in organic-matter content or natural fertility, or are heavy, sticky, and difficult to handle or work.

796–738—67——4

TABLE 5.—*Brief description of soils and their*

Map symbol	Soil	Description of soil	Depth from surface	Classification
				USDA texture
			In.	
Aa	Amarillo loamy fine sand, 0 to 3 percent slopes.	3 to 4 feet of wind-deposited material over soft caliche.	0 to 10 10 to 51	Loamy fine sand Sandy clay loan
Ab Ac	Amarillo fine sandy loam, 0 to 1 percent slopes. Amarillo fine sandy loam, 1 to 3 percent slopes.	3 to 4 feet of wind-deposited material over soft caliche.	0 to 8 8 to 40	Fine sandy loam Sandy clay loam
Ad Ae	Amarillo loam, 0 to 1 percent slopes. Amarillo loam, 1 to 3 percent slopes.	3 to 4 feet of wind-deposited material over soft caliche.	0 to 8 8 to 44	Loam Sandy clay loam
Af	Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded.	No estimates of engineering properties because characteristics are variable.		
Ag	Arch loamy fine sand.	14 to 18 inches of limy valley fill over soft caliche; nearly level.	0 to 8 8 to 18	Loamy fine sand Loam
Ah	Arch fine sandy loam.	14 to 18 inches of limy valley fill over soft caliche; nearly level.	0 to 6 6 to 18	Fine sandy loam Loam
Ak	Arch loam.	14 to 18 inches of limy valley fill over soft caliche; nearly level.	0 to 14	Loam
Am	Arch soils, severely eroded.	No estimates of engineering properties because characteristics are variable.		
An	Arvana loamy fine sand, 0 to 3 percent slopes.	20 to 36 inches of wind-deposited material over several feet of hard caliche.	0 to 8 8 to 28	Loamy fine sand Sandy clay loam
Ap Ar	Arvana fine sandy loam, 0 to 1 percent slopes. Arvana fine sandy loam, 1 to 3 percent slopes.	20 to 36 inches of wind-deposited material over hard caliche.	0 to 8 8 to 28	Fine sandy loam Sandy clay loam
Ao	Arvana loamy fine sand, shallow, 0 to 1 percent slopes.	10 to 20 inches of wind-deposited material over hard caliche.	0 to 6 6 to 14	Loamy fine sand Sandy clay loam
As	Arvana fine sandy loam, shallow, 0 to 1 percent slopes.	10 to 14 inches of wind-deposited material over hard caliche.	0 to 8 8 to 14	Fine sandy loam Clay loam
Av	Arvana soils, 0 to 3 percent slopes, severely eroded.	No estimates of engineering properties because characteristics are variable.		
Ba	Berthoud sandy loam, 2 to 9 percent slopes.	More than 5 feet of calcareous sediments	0 to 60	Sandy loam
Bb	Bippus and Spur soils.	No estimates of engineering properties because characteristics are variable.		
Bc	Blackwater loam.	14 to 24 inches of valley fill over several feet of hard caliche; nearly level.	0 to 9 9 to 22	Loam Clay
Bd	Blown-out and dune land.	No estimates of engineering properties because characteristics are variable.		
Be	Brownfield fine sand.	2 feet of fine sand over 3 to 6 feet of clay-sand material; wind deposited; gently sloping.	0 to 23 23 to 64+	Fine sand Sandy clay loam
Bf	Brownfield soils, severely eroded.	No estimates of engineering properties because characteristics are variable.		
Ca	Church clay loam.	More than 5 feet of limy lake-bed sediments; slowly permeable; nearly level.	0 to 7 7 to 60	Clay loam Clay loam
Cb	Church soils, severely eroded.	No estimates of engineering properties because characteristics are variable.		

estimated physical and chemical properties

Classification—Continued		Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of depth*	*pH*	
SM	A-2	100	100	15 to 25	2.5 to 5.0	0.100	6.6 to 7.3	Low.
SC-CL	A-6 or A-4	100	100	40 to 55	0.80 to 1.50	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
SC or CL	A-6 or A-4	100	100	40 to 55	0.80 to 1.50	.183	7.4 to 7.8	Low to moderate.
ML-CL	A-4	100	100	50 to 65	1.50 to 2.50	.175	6.6 to 7.3	Low.
SC	A-6	100	100	40 to 55	0.80 to 1.50	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	20 to 30	2.5 to 5.0	.075	6.6 to 7.3	Low.
CL	A-6 or A-4	100	100	50 to 65	0.80 to 1.5	.175	7.4 to 7.8	Low to moderate.
SM-SC	A-4	100	100	30 to 40	1.5 to 2.5	.125	7.4 to 7.8	Low.
CL	A-6 or A-4	100	100	50 to 65	0.80 to 1.5	.175	7.4 to 7.8	Low to moderate.
MC-CL	A-4	100	100	50 to 65	1.5 to 2.5	.175	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	15 to 25	2.5 to 5.0	.100	6.6 to 7.3	Low.
SC or CL	A-6	100	100	40 to 55	0.80 to 1.5	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
SC or CL	A-4 or A-6	100	100	40 to 55	0.80 to 1.50	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	15 to 25	2.5 to 5.0	.100	6.6 to 7.3	Low.
SC or CL	A-6	100	100	40 to 55	0.80 to 1.5	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
ML-CL	A-4	100	100	50 to 65	0.5 to 0.8	.183	7.4 to 7.8	Low to moderate.
SM or ML	A-4	100	100	40 to 55	2.5 to 5.0	.125	6.6 to 7.3	Low.
ML-CL	A-4	100	100	60 to 75	0.80 to 1.5	.175	7.4 to 7.8	Low to moderate.
CH	A-7	100	100	70 to 85	0.05 to .20	.192	7.4 to 7.8	High.
SP-SM	A-2 or A-3	100	100	5 to 12	5.0 to 10.0	.058	6.6 to 7.3	Low.
SC	A-4 or A-6	100	100	30 to 45	0.80 to 1.5	.183	6.6 to 7.3	Low to moderate.
CL	A-6	100	100	60 to 75	0.50 to 0.80	.183	7.4 to 7.8	Moderate.
CH	A-7	100	100	60 to 70	0.20 to 0.50	.183	7.9 to 8.4	High.

TABLE 5.—*Brief description of soils and their*

Map symbol	Soil	Description of soil	Depth from surface	Classification
				USDA texture
			In.	
Cc	Clovis loamy fine sand, 0 to 3 percent slopes.	2 to 3 feet of wind-deposited sediments over permeable soft caliche.	0 to 8 8 to 30	Loamy fine sand Sandy clay loam
Cd Ce	Clovis fine sandy loam, 0 to 1 percent slopes. Clovis fine sandy loam, 1 to 3 percent slopes.	2 to 3 feet of wind-deposited sediments over permeable soft caliche.	0 to 8 8 to 30	Fine sandy loam Sandy clay loam
Cf Cg	Clovis loam, 0 to 1 percent slopes. Clovis loam, 1 to 3 percent slopes.	2 to 3 feet of wind-deposited sediments over permeable soft caliche.	0 to 5 5 to 26	Loam Sandy clay loam
Dr	Drake soils.	No estimates of engineering properties because characteristics are variable.		
Go	Gomez loamy fine sand.	2 to 3 feet of wind-deposited material over moderately permeable soft caliche; gently sloping.	0 to 12 12 to 22 22 to 36	Loamy fine sand Fine sandy loam Loam
Hg	Hilly gravelly land.	No estimates of engineering properties because characteristics are variable.		
Ka	Kimbrough fine sandy loam.	10 inches or less of moderately coarse textured material over several feet of hard caliche; nearly level.	0 to 10	Fine sandy loam
Kb	Kimbrough loam.	10 inches or less of medium-textured material over several feet of hard caliche; nearly level.	0 to 8	Loam
Mc	Mansker and Portales fine sandy loams, 1 to 3 percent slopes.	Mansker: 10 to 20 inches of calcareous, wind-deposited sediments over gravelly or cobbly caliche with soft caliche binder. Portales: See description of Portales fine sandy loam, 0 to 1 percent slopes.	0 to 20	Fine sandy loam
Md	Mansker and Portales loams, 1 to 3 percent slopes.	Mansker: 10 to 20 inches of calcareous, wind-deposited sediments over gravelly or cobbly caliche with soft caliche binder. Portales: See description of Portales loam, 0 to 1 percent slopes.	0 to 17	Loam
Me	Montoya clay loam.	More than 5 feet of alluvium; poorly graded; low stability and slowly permeable.	0 to 13 13 to 60	Clay loam Silty clay
Ot	Olton loam, 0 to 1 percent slopes.	3 to 5 feet of wind-deposited sediments over soft caliche; moderately permeable.	0 to 4 4 to 28 28 to 60	Loam Clay loam Sandy clay loam
Oz	Olton-Zita loams, 0 to 1 percent slopes.	Olton: See description of Olton loam, 0 to 1 percent slopes. Zita: See description of Zita loam, 0 to 1 percent slopes.		
Pa	Portales fine sandy loam, 0 to 1 percent slopes.	2 to 3 feet of valley-filled sediments over soft caliche.	0 to 6 6 to 28	Fine sandy loam Sandy clay loam
Pb	Portales loam, 0 to 1 percent slopes.	2 to 3 feet of valley-filled sediments over soft caliche.	0 to 8 8 to 27	Loam Sandy clay loam
Pc	Potter soils, 0 to 9 percent slopes.	No estimates of engineering properties because characteristics are variable.		
Ra	Riverwash.	No estimates of engineering properties because characteristics are variable.		
Rb	Rough broken land.	No estimates of engineering properties because characteristics are variable.		

estimated physical and chemical properties—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of depth*	*pH*	
SM	A-2	100	100	15 to 25	2.5 to 5.0	0.100	6.6 to 7.3	Low.
SC-CL	A-6 or A-4	100	100	40 to 55	0.80 to 1.5	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
SC or CL	A-6 or A-4	100	100	40 to 55	0.80 to 1.5	.183	7.4 to 7.8	Low to moderate.
ML-CL	A-4	100	100	50 to 65	1.5 to 2.5	.175	6.6 to 7.3	Low.
CL or SC	A-4 or A-6	100	100	40 to 55	0.80 to 1.50	.183	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	20 to 30	2.5 to 5.0	.075	6.6 to 7.3	Low.
SM-SC	A-2 or A-4	100	100	30 to 40	1.5 to 2.5	.125	7.4 to 7.8	Low.
CL	A-4 or A-6	100	100	50 to 65	1.5 to 2.5	.175	7.4 to 7.8	Low to moderate.
SM	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
ML-CL	A-4	100	100	50 to 65	1.5 to 2.5	.167	6.6 to 7.3	Low.
SM-SC	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
ML-CL	A-4	100	100	50 to 65	1.5 to 2.5	.175	6.6 to 7.3	Low.
CL	A-6 or A-7	100	100	70 to 80	0.20 to 0.50	.183	7.4 to 7.8	Moderate.
CH	A-7	100	100	85 to 95	0.05 to 0.20	.192	7.9 to 8.4	High.
ML-CL	A-4	100	100	50 to 65	1.5 to 2.5	.175	6.6 to 7.3	Low.
CL	A-6	100	100	70 to 80	0.50 to 0.80	.183	7.4 to 7.8	Moderate.
CL or SC	A-4 or A-6	100	100	40 to 55	0.8 to 1.5	.183	7.4 to 7.8	Low to moderate.
SM-SC	A-2	100	100	25 to 35	2.5 to 5.0	.125	6.6 to 7.3	Low.
CL or SC	A-4 or A-6	100	100	40 to 55	0.80 to 1.5	.183	7.4 to 7.8	Low to moderate.
ML-CL	A-4	100	100	50 to 65	1.5 to 2.5	.175	6.6 to 7.3	Low.
CL or SC	A-4 or A-6	100	100	40 to 55	0.80 to 1.5	.183	7.4 to 7.8	Low to moderate.

TABLE 5.—*Brief description of soils and their*

Map symbol	Soil	Description of soil	Depth from surface	Classification
				USDA texture
			In.	
Sf	Springer loamy fine sand.	More than 5 feet of wind-deposited material; gently sloping.	0 to 14 14 to 48 48 to 60+	Loamy fine sand Fine sandy loam Loamy fine sand
Sp	Springer soils, severely eroded.	No estimates of engineering properties because characteristics are variable.		
St Su	Stegall loam, 0 to 1 percent slopes. Stegall loam, 1 to 3 percent slopes.	2 to 3 feet of wind-deposited material; over several feet of hard caliche.	0 to 6 6 to 24	Loam Sandy clay loam
Sw	Stegall loam, shallow, 0 to 1 percent slopes.	10 to 20 inches of wind-deposited material over several feet of hard caliche.	0 to 6 6 to 14	Loam Sandy clay loam
Tf	Tivoli fine sand.	More than 5 feet of wind-deposited loose sand; rolling, dunelike sandhills.	0 to 61+	Fine sand
Th	Tivoli-Arch complex.	Tivoli: See description of Tivoli fine sand. Arch: See description of Arch loamy fine sand.		
Tr	Travessilla loam.	Less than 20 inches to intermixed, broken, weathered material; steep.	0 to 8	Loam
Zf	Zita fine sandy loam, 0 to 1 percent slopes.	2 to 3 feet of mixed wind-deposited and alluvial soft caliche sediments.	0 to 5 5 to 30	Fine sandy loam Sandy clay loam
Zm	Zita loam, 0 to 1 percent slopes.	2 to 3 feet of mixed wind-deposited and alluvial soft caliche sediments.	0 to 6 6 to 36	Loam Sandy clay loam

The suitability of a soil for road fill depends largely on the texture of the material and on its natural water content. Compaction characteristics, erodibility, depth to bedrock, and presence of rock within the normal depth of road excavation are also features that should be considered. Highly plastic soil material with high natural water content is rated very poor. Highly erodible soils (silt and fine sand) are difficult to compact, require moderately gentle slopes, and a quick vegetative cover. They are rated poor or fair.

The degree of limitation of the soils for sewage disposal fields and lagoons is given as slight, moderate, or severe.

The soil features affecting the use of a soil for a specified purpose are based on the normal profile of that soil as shown in table 5. Variations in the profile may change the ratings of the soil for some structures and practices.

Engineering test data

Table 7 presents data obtained by laboratory tests of samples of 7 different soils in the county. The soils shown in this table were sampled at one or more locations. The engineering properties of a soil at a specific location are indicated by this test data, but there may be variations in the properties of this soil at other locations in the county. Even for those soils sampled in more than one location, the test data probably do not show the maximum degree of variation in properties.

The engineering soil classifications are based on data obtained by mechanical analysis and by tests to determine the liquid limit and plasticity index.

Engineering data by soil associations

The correlation of engineering data and soil properties according to soil associations, or soil patterns, can be useful in estimating the suitability of certain areas for engineering purposes. Information concerning the general problems and hazards to be encountered in the different soil associations will be helpful to farmers, ranchers, and agricultural technicians in the selection of areas for various engineering structures or practices. For more detailed description of each soil association, turn to the section "General Soil Map." A colored map at the back of this report shows the general extent and location of the soil associations in the county.

AMARILLO-CLOVIS LOAMS ASSOCIATION; DEEP AND MODERATELY DEEP HARDLAND.—All of the soils in this association except the Stegall are underlain by soft caliche, commonly at a depth of less than 4 feet. The Stegall soils, which are minor soils, are underlain by hard caliche. The soils underlain by soft caliche generally have sufficient silt and clay throughout their solum for the construction of ponds and dams. All of the soils are suitable for terraces, diversions, waterways, and other small earthen structures. Generally, the water supply in this association is not adequate for irrigation.

estimated physical and chemical properties—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of depth*	*pH*	
SM	A-2	100	100	15 to 25	2. 5 to 5. 0	0. 100	6. 6 to 7. 3	Low.
SM-SC	A-2	100	100	25 to 35	2. 5 to 5. 0	. 125	6. 6 to 7. 3	Low.
SM	A-2	100	100	15 to 25	2. 5 to 5. 0	. 100	6. 6 to 7. 3	Low.
ML-CL	A-4	100	100	50 to 65	1. 5 to 2. 5	. 167	6. 6 to 7. 3	Low.
CL or SC	A-6	100	100	40 to 55	0. 80 to 1. 5	. 183	7. 4 to 7. 8	Low to moderate.
ML-CL	A-4	100	100	50 to 65	1. 5 to 2. 5	. 167	6. 6 to 7. 3	Low.
CL or SC	A-6	100	100	40 to 55	0. 80 to 1. 5	. 183	7. 4 to 7. 8	Low to moderate.
SP or SM-SP	A-3	100	100	0 to 10	5. 0 to 10. 0	. 058	6. 6 to 7. 3	Low.
CL	A-6	100	100	50 to 65	0. 8 to 1. 5	. 175	6. 6 to 7. 3	Moderate.
SM-SC	A-2	100	100	25 to 35	2. 5 to 5. 0	. 125	6. 6 to 7. 3	Low.
CL or SC	A-6	100	100	40 to 55	0. 80 to 1. 5	. 183	7. 4 to 7. 8	Low to moderate.
ML-CL	A-4	100	100	50 to 65	1. 5 to 2. 5	. 175	6. 6 to 7. 3	Low.
CL or SC	A-6	100	100	40 to 55	.80 to 1. 5	. 183	7. 4 to 7. 8	Low to moderate.

Amarillo-Clovis Fine Sandy Loams Association; Deep and Moderately Deep, Moderately Sandy Land.—All of the soils in this association except the Arvana are underlain by soft caliche, commonly at a depth of less than 4 feet. The Arvana soils, which are minor soils, are underlain by hard caliche.

Ponds function well on some soils if a core is keyed through the sandy surface layer. Because of the sandy surface layer, however, the control of erosion in spillways is difficult.

Terraces, waterways, diversions, and other small earthen structures generally are suitable if they are carefully constructed and properly maintained. The main problem in the maintenance of these structures is control of wind erosion.

The quality of the water in this association is good, and where the supply of water from wells is adequate, the soils are irrigated.

Amarillo-Clovis Loamy Fine Sands Association; Deep and Moderately Deep Sandy Land.—The principal soils of this association are underlain by soft caliche at a depth of 2 to 4 feet. The Arvana soils, which are minor soils, are underlain by hard caliche at a depth of 20 to 36 inches.

Ponds function well on the soils of this association if a core is keyed through the sandy surface layer. Runoff is slow, however, and drifting sand may be a problem.

Terraces, waterways, diversions, and other small earthen structures generally are difficult to maintain because of wind erosion. If irrigation is planned, sprinkler systems are best suited.

Tivoli-Springer-Brownfield Sands Association; Deep, Loose Sandy Land.—The very sandy soils in this association are not suitable for structures because of drifting sand, severe wind erosion, rapid rate of water intake, and little or no runoff.

Sand and, in places, gravel underlie all of the soils except the Brownfield. The removal of 10 feet or more of soil material from a carefully selected site exposes large deposits of sand and gravel of the Ogallala formation.

Potter-Mansker Association; Very Shallow to Moderately Deep, Calcareous Soils.—This association consists of shallow or very shallow, calcareous, medium-textured or gravelly soils and rock outcrops.

Metal pipes or lines are subject to corrosion if buried in some of these soils because of the high content of lime. Corrosion is a problem in those soils where resistance readings are 5,000 ohms or less.

Structures, both large and small, require careful site selection because of the gravel, rock, high content of lime, rough topography, or hazard of wind and water erosion.

Much of the irrigated land in the county occurs within this association. The conveyance system consists mainly of underground pipes. The water generally is of good quality, except in a narrow strip in the southeastern part of the Portales Valley where the salt content is high.

TABLE 6.—*Interpretations of engineering*

Soil and map symbol	Suitability as a source of—		Degree of limitation for filter fields and lagoons	Soil features affecting—	
	Topsoil	Road fill		Highway location	Pipelines
Amarillo loamy fine sand (Aa).	Poor to depth of 10 inches; fair between 10 and 51 inches.	Fair	Slight	Drifting sand	Soil features favorable.
Amarillo fine sandy loam (Ab, Ac).	Fair	Fair	Slight	Soil features favorable.	Soil features favorable.
Amarillo loam (Ad, Ae)	Good	Fair	Slight	Soil features favorable.	Soil features favorable.
Armillo and Clovis soils, severely eroded (Af):					
Amarillo	Fair	Fair	Slight	Drifting sand; small dunes.	Soil features favorable.
Clovis	Fair	Fair	Slight	Drifting sand; small dunes.	Soil features favorable.
Arch loamy fine sand (Ag).	Poor	Poor [1]	Severe; moderate permeability; soft caliche at depth of 14 to 18 inches.	Soft caliche at depth of 14 to 18 inches.	Contains lime and some gypsum.
Arch fine sandy loam (Ah).	Poor	Poor [1]	Severe; moderate permeability; soft caliche at depth of 14 to 18 inches.	Soft caliche at depth of 14 to 18 inches.	Contains lime and some gypsum.
Arch loam (Ak)	Fair	Poor [1]	Severe; moderate permeability; soft caliche at depth of 14 to 18 inches.	Soft caliche at depth of 14 to 18 inches.	Contains lime and some gypsum.
Arch soils, severely eroded (Am).	Poor	Poor [1]	Severe; moderate permeability; soft caliche at depth of 12 inches or less.	Soft caliche at depth of 12 inches or less.	Contains lime and some gypsum.
Arvana loamy fine sand (An).	Poor	Fair [1]	Severe; hard caliche at depth of less than 3 feet.	Layer of hard caliche, 2 to 3 feet thick, below depth of 24 to 36 inches; drifting sand.	Layer of hard caliche, 2 to 3 feet thick, below depth of 24 to 36 inches.
Arvana loamy fine sand, shallow (Ao).	Poor	Fair or good to depth of 14 inches.[1]	Severe; hard caliche at depth of less than 20 inches.	Layer of hard caliche, 2 to 3 feet thick at depth of less than 20 inches; drifting sand.	Hard caliche at depth of less than 20 inches.

See footnote at end of table.

properties of soils

Soil features affecting—Continued					
Farm ponds		Irrigation	Terraces and diversions	Land leveling	Foundation for low buildings
Reservoir area	Embankment				
Requires compaction	Soil features favorable.	Rapid intake rate in surface layer; subject to severe wind erosion; best suited to sprinkler irrigation.	Sandy surface layer creates maintenance problem because of wind erosion; not suitable for terracing.	Soil features favorable; not practical on slopes of more than 1 percent.	Soil features favorable.
Requires compaction	Soil features favorable.	Soil features favorable; suited to surface or sprinkler irrigation.	Soil features favorable.	Soil features favorable; not practical on slopes of more than 1 percent.	Soil features favorable.
Requires compaction	Soil features favorable.	Soil features favorable; slopes greater than 1 percent best suited to sprinkler irrigation.	Soil features favorable.	Soil features favorable; not practical on slopes of more than 1 percent.	Soil features favorable.
Requires compaction	Soil features favorable.	Rough and hummocky; best suited to sprinkler irrigation.	Rough and hummocky.	Soil features favorable; not practical on slopes of more than 1 percent.	Soil features favorable.
Requires compaction	Soil features favorable.	Rough and hummocky; best suited to sprinkler irrigation.	Rough and hummocky.	Soil features favorable; not practical on slopes of more than 1 percent.	Soil features favorable.
Seepage excessive after first year; high content of lime.	Seepage excessive after first year; erodible.	Rapid surface intake rate; subject to severe wind erosion.	Sandy surface layer creates maintenance problem because of wind erosion; not suitable for terracing.	Lime content limits cuts and increases maintenance problem.	Moderate shrink-swell potential; fair bearing capacity.
Seepage rate increases with time after construction; high content of lime.	Erodible; difficult to seal.	Subject to severe wind erosion.	Lime content limits cuts and increases maintenance problem.	Lime content limits cuts and increases maintenance problem.	Moderate shrink-swell potential; fair bearing capacity.
Seepage rate increases with age; high content of lime.	Erodible; difficult to seal.	Suitable for surface or sprinkler irrigation.	Lime content limits cuts and increases maintenance problem.	Lime content limits cuts.	Moderate shrink-swell potential; fair bearing capacity.
Seepage rate increases with time after construction; high content of lime.	Erodible; difficult to seal.	Not applicable	Lime content increases maintenance problem.	Not applicable	Moderate shrink-swell potential; fair bearing capacity.
Suitability questionable; hard caliche at depth of 2 to 3 feet; seepage a problem.	Limited fill material.	Rapid surface intake rate; subject to severe wind erosion; best suited to sprinkler irrigation.	Not applicable	Cuts limited by hard caliche; not practical on slopes of more than 1 percent.	Soil features favorable.
Not applicable	Not applicable	Suitable for sprinkler irrigation; susceptible to severe wind erosion.	Not applicable	Cuts severely limited by hard caliche at depth of less than 20 inches.	Soil features favorable.

TABLE 6.—*Interpretations of engineering*

Soil and map symbol	Suitability as a source of—		Degree of limitation for filter fields and lagoons	Soil features affecting—	
	Topsoil	Road fill		Highway location	Pipelines
Arvana fine sandy loam, shallow (As).	Poor	Fair or good to depth of 14 inches.[1]	Severe; hard caliche at depth of less than 20 inches.	Layer of hard caliche, 2 to 3 feet thick, at depth of less than 20 inches; drifting sand.	Hard caliche at depth of less than 20 inches.
Arvana fine sandy loam (Ap, Ar).	Fair	Fair	Severe; hard caliche at a depth of less than 3 feet.	Layer of hard caliche, 2 to 3 feet thick, below depth of 2 to 3 feet.	Layer of hard caliche, 2 to 3 feet thick, below depth of 2 to 3 feet.
Arvana soils, severely eroded (Av).	Poor	Fair to depth of 8 inches.[1]	Severe; hard caliche at depth of less than 8 inches; danger of pollution if excavated below hard caliche.	Hard caliche, 2 to 3 feet thick, at depth of less than 8 inches.	Hard caliche at depth of less than 8 inches.
Berthoud sandy loam (Ba).	Fair	Fair	Slight	Soil features favorable.	Soil features favorable.
Bippus and Spur soils (Bb).	Good	Poor	Moderate; moderate permeability.	Occasional flooding	Soil features favorable.
Blackwater loam (Bc)	Fair to depth of 9 inches.	Fair to depth of 9 inches.	Severe; hard caliche at depth of less than 24 inches; slow permeability.	Layer of hard caliche 2 to 3 feet thick at depth of less than 24 inches.	Hard caliche at depth of less than 24 inches.
Blown-out and dune land (Dune land only) (Bd).	Poor	Good if soil binder is added.	Moderate; drifting sand; highly erodible.	Drifting sand and dunes; sand hampers movement of equipment; dunes range from 10 to 20 feet in size.	Site selection a problem; drifting dunes may expose lines.
Brownfield fine sand (Be).	Poor	Good if soil binder is added.	Slight	Drifting sand; sand hampers movement of equipment.	Deep cover needed to prevent exposure by wind; trench banks unstable because of loose sand.
Brownfield soils, severely eroded (Bf).	Poor	Good if soil binder is added.	Moderate; drifting sand.	Active dunes, 4 to 12 feet in size; blowing sand.	Selective placement of pipe location, or removal of dunes.
Church clay loam (Ca)	Poor	Very poor	Severe; slow permeability; flooding.	Flooding or ponding; high shrink-swell potential; unstable when wet.	Substratum permanently wet; movement of equipment restricted if soil is wet.
Church soils, severely eroded (Cb).	Poor	Very poor	Severe; slow permeability; flooding.	Flooding or ponding; high shrink-swell potential; unstable when wet.	Substratum permanently wet; movement of equipment restricted if soil is wet.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Farm ponds		Irrigation	Terraces and diversions	Land leveling	Foundation for low buildings
Reservoir area	Embankment				
Not applicable	Not applicable	Suitable for sprinkler irrigation; susceptible to severe wind erosion.	Not applicable	Cuts severely limited by hard caliche at depth of less than 20 inches.	Soil features favorable.
Suitability questionable; hard caliche at a depth of 2 to 3 feet; seepage a problem.	Limited fill material.	Suitable for surface or sprinkler irrigation.	Borrow area cuts limited by hard caliche.	Cuts limited by hard caliche at depth of less than 36 inches; not practical on slopes of more than 1 percent.	Soil features favorable.
Not applicable	Limited fill material.	Not applicable	Not applicable	Not applicable	Soil features favorable.
Not applicable	Erodible and pervious.	Not applicable	Not applicable	Not applicable	Soil features favorable.
Erodible	Erodible	Soil features favorable if protection from overflow is adequate.	Soil features favorable.	Soil features favorable if protection from overflow is adequate.	Occasional flooding.
No excavation in reservoir; requires compaction.	Requires borrow area outside reservoir; limited fill material.	Slowly permeable; root development limited.	Soil features favorable.	Cuts limited by hard caliche at depth of less than 36 inches.	Soil features favorable.
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Undercutting by wind a problem; requires confinement or binder.
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Surface 2 feet easily eroded if vegetation is removed.
Limited excavation in reservoir.	Material must be selected from clay-sand layer.	Not applicable	Not applicable	Not applicable	Drifting sand.
Possible gypsum strata.	Unstable; difficult to work.	Slowly permeable; subject to severe wind erosion; saline in places.	Wind erosion creates maintenance problem.	Cuts limited by strongly calcareous clay.	Flooding or ponding; unstable when wet.
Possible gypsum strata.	Unstable; difficult to work.	Slowly permeable; subject to severe wind erosion; saline in places.	Wind erosion creates maintenance problem.	Cuts limited by strongly calcareous clay.	Flooding or ponding; unstable when wet.

TABLE 6.—*Interpretations of engineering*

Soil and map symbol	Suitability as a source of—		Degree of limitation for filter fields and lagoons	Soil features affecting—	
	Topsoil	Road fill		Highway location	Pipelines
Clovis loamy fine sand (Cc).	Poor to depth of 12 inches; fair between 12 and 24 inches.	Fair	Slight	Drifting sand	Soil features favorable.
Clovis fine sandy loam (Cd, Ce).	Fair to depth of 24 inches.	Fair	Slight	Soil features favorable.	Soil features favorable.
Clovis loam (Cf, Cg)	Good to depth of 24 inches.	Fair	Slight; moderate permeability for lagoons.	Soil features favorable.	Soil features favorable.
Drake soils (Dr)	Poor	Fair to depth of 19 inches; poor between 19 and 60 inches or more.	Slight	Soil features favorable.	Soil features favorable.
Gomez loamy fine sand (Go).	Poor	Good to depth of 12 inches; fair between 12 and 22 inches.	Slight	Blowing sand; soft caliche at depth of 2 to 3 feet.	Blowing sand
Hilly gravelly land (Hg)	Poor	Very good	Severe; danger of contamination.	Dry washes and gullies.	Gravelly; dry washes and gullies.
Kimbrough fine sandy loam (Ka).	Fair to depth of 12 inches or less.	Good to depth of 8 inches.[1]	Severe; hard caliche at depth of 12 inches or less; danger of pollution if excavated below hard caliche.	Layer of hard caliche, 2 to 3 feet thick, at depth of 12 inches or less.	Hard caliche at depth of 12 inches or less.
Kimbrough loam (Kb)	Good to depth of 12 inches or less.	Fair to depth of 8 inches.[1]	Severe; hard caliche at depth of 12 inches or less; danger of pollution if excavated below hard caliche.	Layer of hard caliche, 2 to 3 feet thick, at depth of 12 inches or less.	Hard caliche at depth of 12 inches or less.
Mansker and Portales fine sandy loams (Mc):					
Mansker	Poor	Good	Slight	Soil features favorable.	Soil features favorable.
Portales	Fair	Fair	Slight	Soil features favorable.	Soil features favorable.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Farm ponds		Irrigation	Terraces and diversions	Land leveling	Foundation for low buildings
Reservoir area	Embankment				
Requires compaction.	Soil features favorable.	Rapid intake rate in surface layer; subject to severe wind erosion; best suited to sprinkler irrigation.	Not applicable	Cuts limited by soft caliche at depth between 20 and 36 inches.	Soil features favorable.
Requires compaction.	Soil features favorable.	Suitable for surface or sprinkler irrigation.	Not applicable	Cuts limited by soft caliche at depth between 20 and 36 inches; leveling limited to slopes of less than 1 percent.	Soil features favorable.
Requires compaction.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Cuts limited by soft caliche at depth between 20 and 36 inches; leveling limited to slopes of less than 1 percent.	Soil features favorable.
Seepage rate increases with time after construction; high content of lime.	Erodible; difficult to seal.	Subject to severe wind erosion; suitable for surface or sprinkler irrigation.	Not applicable	High lime content limits cuts; leveling not practical on slopes of more than 1 percent.	Soil features favorable.
Not applicable	Not applicable	Rapid intake rate; low water-holding capacity; subject to wind erosion; suitable for sprinkler irrigation.	Not applicable	Cuts limited by soft caliche.	Blowing sand.
Not applicable	Very permeable; requires binder.	Not applicable; gravelly, steep.	Not applicable	Not applicable	Soil features favorable.
Not applicable	Not applicable	Not applicable; shallow.	Not applicable; shallow.	Not applicable; shallow.	Soil features favorable.
Not applicable	Not applicable	Not applicable; shallow.	Not applicable; shallow.	Not applicable; shallow.	Soil features favorable.
Permeable; soft or cobbly caliche at depth of 10 to 20 inches.	Permeable	Suitable for sprinkler irrigation.	Limy soil from borrow area creates maintenance problem because of wind erosion.	Not applicable	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Suitable for surface or sprinkler irrigation.	Soil features favorable.	Soil features favorable.	Soil features favorable.

TABLE 6.—*Interpretations of engineering*

Soil and map symbol	Suitability as a source of—		Degree of limitation for filter fields and lagoons	Soil features affecting—	
	Topsoil	Road fill		Highway location	Pipelines
Mansker and Portales loams (Md):					
Mansker	Fair to depth of 12 inches.	Good	Slight	Soil features favorable.	Soil features favorable.
Portales	Good	Fair	Slight	Soil features favorable.	Soil features favorable.
Montoya clay loam (Me).	Poor	Very poor	Severe; slow permeability.	Periodic flooding; high shrink-swell potential; erodible; difficult to work.	Flooding; equipment difficult to operate if soil is wet.
Olton loam (Ot)	Good to depth of 12 inches; fair between 12 and 60 inches.	Poor	Moderate; slow permeability.	Soil features favorable.	Soil features favorable.
Olton-Zita loams (Oz):					
Olton	Good to depth of 12 inches; fair between 12 and 60 inches.	Poor	Moderate; slow permeability.	Soil features favorable.	Soil features favorable.
Zita	Good	Fair	Slight	Soil features favorable.	Soil features favorable.
Portales fine sandy loam (Pa).	Fair	Fair	Slight	Soil features favorable.	Soil features favorable.
Portales loam (Pb)	Good	Fair	Slight	Soil features favorable.	Soil features favorable.
Potter soils (Pc)	Poor	Very good [1]	Severe; hard fractured caliche at depth of less than 10 inches.	Fragments of soft and hard caliche at depth of less than 10 inches.	Fragments of mixed soft and hard caliche at depth of less than 10 inches.
Riverwash (Ra)	Unsuitable	Good, but requires site selection.	Severe; flooding; danger of pollution.	Flooding	Flooding; gravelly
Rough broken land (Rb).	Poor	Good; mixed geologic material.[1]	Severe; danger of pollution; problems in construction.	Rough topography	Rough topography; rocky; installation difficult.
Springer loamy fine sand (Sf).	Poor	Fair or good	Slight	Blowing and drifting sand; deep sand hampers movement of equipment.	Deep cover needed to prevent exposure by wind; trench banks unstable.

See footnote at end of table.

properties of soils—Continued

Soil features affecting—Continued						
Farm ponds		Irrigation	Terraces and diversions	Land leveling	Foundation for low buildings
Reservoir area	Embankment				
Permeable; soft or cobbly caliche at depth of 10 to 20 inches.	Permeable	Suitable for sprinkler irrigation.	Limy material from borrow area creates maintenance problem because of wind erosion.	Cuts limited by soft caliche.	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Soil features favorable.
Periodic flooding; subject to piping.	Difficult to work; unstable.	Not applicable	Highly erodible; subject to piping.	Not applicable	Soil features favorable.
Requires compaction.	Soil features favorable.	Best suited to surface irrigation.	Soil features favorable.	Soil features favorable.	Soil features favorable.
Requires compaction.	Soil features favorable.	Best suited to surface irrigation.	Soil features favorable.	Soil features favorable.	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Cuts limited	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Suitable for surface or sprinkler irrigation.	Soil features favorable.	Soil features favorable.	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Soil features favorable.
Not applicable	Not applicable	Not applicable; shallow.	Not applicable; shallow.	Not applicable; shallow.	Soil features favorable.
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Flooding.
Not applicable	Not applicable	Not applicable	Not applicable; rough terrain.	Not applicable	Rough topography; rocky.
Very permeable	Very permeable; erodible.	Best suited to sprinkler irrigation; rapid intake rate; sandy surface layer and subsoil; subject to severe wind erosion.	Not applicable	Leveling limited to slopes of less than 1 percent; wind erosion increases maintenance problem.	Soil features favorable.

TABLE 6.—*Interpretations of engineering*

Soil and map symbol	Suitability as a source of—		Degree of limitation for filter fields and lagoons	Soil features affecting—	
	Topsoil	Road fill		Highway location	Pipelines
Springer soils, severely eroded (Sp).	Poor	Fair	Slight	Blowing and drifting sand; deep sand hampers movement of equipment.	Deep cover needed to prevent exposure by wind; trench banks unstable.
Stegall loam (St, Su)	Good	Fair	Severe; layer of hard caliche, 2 to 3 feet thick, at depth of 3 feet.	Layer of hard caliche, 2 to 3 feet thick, at depth of 2 to 3 feet.	Hard caliche at depth of less than 3 feet.
Stegall loam, shallow (Sw).	Good	Fair to depth of 10 to 20 inches.	Severe; layer of hard caliche, 2 to 3 feet thick, at depth of 10 to 20 inches; danger of pollution.	Layer of hard caliche, 2 to 3 feet thick, at depth of 10 to 20 inches.	Hard caliche at depth of less than 20 inches.
Tivoli fine sand (Tf)	Poor	Good if soil binder is added.	Severe; blowing sand	Blowing and drifting sand; deep sand hampers movement of equipment.	Deep cover needed to prevent exposure by wind.
Tivoli-Arch complex (Th): Tivoli	Poor	Good if soil binder is added.	Severe; blowing sand	Blowing and drifting sand; deep sand hampers movement of equipment.	Deep cover needed to prevent exposure by wind.
Arch	Poor	Poor	Severe; moderate permeability; soft caliche at depth of 14 to 18 inches.	Soft caliche at depth of 14 to 18 inches.	Contains lime and some gypsum.
Travessilla loam (Tr)	Poor	Poor [1]	Severe	Rough topography; weathered sandstone at depth of less than 20 inches.	Steep, rough topography; weathered sandstone at depth of less than 20 inches.
Zita fine sandy loam (Zf).	Fair	Fair	Slight	Soil features favorable.	Soil features favorable.
Zita loam (Zm)	Good	Fair	Slight	Soil features favorable.	Soil features favorable.

[1] Suitable as a source of crushed stone.

properties of soils—Continued

Soil features affecting—Continued						
Farm ponds		Irrigation	Terraces and diversions	Land leveling	Foundation for low buildings
Reservoir area	Embankment				
Very permeable	Very permeable; erodible.	Not applicable	Not applicable	Not applicable	Soil features favorable.
Limited excavation; requires compaction.	Limited borrow	Suitable for surface or sprinkler irrigation.	Hard caliche between depth of 20 and 36 inches limits cuts in borrow.	Cuts limited by hard caliche at depth between 20 and 36 inches; leveling limited to slopes of less than 1 percent.	Soil features favorable.
Not applicable	Not applicable	Suitable for sprinkler irrigation.	Not applicable; shallow	Not applicable; shallow.	Soil features favorable.
Not applicable	Not applicable	Rapid intake rate; subject to severe wind erosion.	Not applicable	Not applicable	Subject to undercutting by wind; requires confinement or soil binder.
Not applicable	Not applicable	Rapid intake rate, subject to severe wind erosion.	Not applicable	Not applicable	Subject to undercutting by wind; requires confinement or soil binder.
Seepage rate increases with time after construction; high content of lime.	Erodible; difficult to seal.	Subject to severe wind erosion.	Lime content limits cuts and increases maintenance problems.	Lime content limits cuts and increases maintenance problems.	Moderate shrink-swell potential; fair bearing capacity.
Not applicable	Very limited borrow.	Not applicable	Not applicable	Not applicable	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Cuts limited	Soil features favorable.
Soft caliche at depth of 2 to 3 feet; requires compaction.	Soil features favorable.	Soil features favorable.	Soil features favorable.	Cuts limited	Soil features favorable.

TABLE 7.—*Engineering*

[Tests performed by New Mexico State Highway Dept., Materials and Testing Division, in accordance

Soil name and location	Parent material	New Mexico report number	Depth
			Inches
Amarillo loamy fine sand, 0 to 3 percent slopes: 0.05 mile W. of SE. corner sec. 27, T. 1 S, R. 31 E. (Modal)	Coarse-textured eolian sediments.	59-1565	10 to 16
		59-1566	17 to 29
		59-1567	29 to 44
Amarillo loamy fine sand, 0 to 3 percent slopes: NE¼NE¼ sec. 21, T. 3 S., R. 33 E. (Modal)	Coarse-textured eolian sediments.	60-2538	15 to 31
		60-2539	31 to 42
		60-2540	47+
Amarillo fine sandy loam, 0 to 1 percent slopes: 0.15 mile W. and 0.05 mile S. of NE corner sec. 10, T. 2 S., R. 31 E. (Modal)	Moderately coarse textured eolian sediments.	59-1568	9 to 21
		59-1569	21 to 29
		59-1570	29 to 46
Amarillo fine sandy loam, 0 to 1 percent slopes: 1,180 feet N. and 1,980 feet E. of SW. corner sec. 15, T. 2 S., R. 31 E. (Minimal)	Moderately coarse textured eolian sediments.	59-1571	5 to 10
		59-1572	10 to 31
		59-1573	31 to 48
Amarillo fine sandy loam, 1 to 3 percent slopes: 0.4 mile E. and 0.15 mile S. of NW. corner sec. 28, T. 1 S., R 31 E. (Minimal)	Moderately coarse textured eolian sediments.	59-1562	8 to 22
		59-1563	22 to 28
		59-1564	28 to 37
Arvana fine sandy loam, 0 to 1 percent slopes: 0.2 mile W. and 0.2 mile S. of NE. corner sec. 27, T. 1 S., R. 31 E. (Modal)	Moderately coarse textured eolian sediments over hard caliche.	59-1559	0 to 8
		59-1560	8 to 16
		59-1561	16 to 22
Brownfield fine sand: ¼ mile E. and 1,000 feet N. of SW. corner sec. 32, T. 2 S., R. 33 E. (Modal)	Eolian sands and sandy clays.	60-2541	2 to 15
		60-2542	23 to 33
		60-2543	33 to 50
Clovis loam, 0 to 1 percent slopes: 0.1 mile N. and 0.05 mile E. of SW corner sec. 18, T. 4 S., R. 31 E. (Minimal)	Medium-textured eolian sediments.	59-1575	7 to 13
		59-1576	13 to 23
		59-1574	30 to 52
Clovis loam, 0 to 1 percent slopes: ½ mile N. and 790 feet west of SE. corner sec. 22, T. 1 S., R. 31 E. (Modal)	Medium-textured eolian sediments.	59-1556	5 to 14
		59-1557	18 to 26
		59-1558	32 to 50
Clovis loam, 1 to 3 percent slopes: 1,452 feet W. and 395 feet N. of SE. corner sec 27, T. 4 S., R. 31 E. (Maximal)	Medium-textured eolian sediments.	59-1577	9 to 17
		59-1578	22 to 33
		59-1579	48 to 63
Stegall loam, 0 to 1 percent slopes: ¼ mile S. and ¼ mile E. of NW. corner sec. 8, T. 5 S., R. 31 E. (Modal)	Moderately fine textured eolian sediments over hard caliche.	59-1583	2 to 6
		59-1584	8 to 13
		59-1585	18 to 24
Stegall loam, 0 to 1 percent slopes: 0.2 mile W. and 0.4 mile N. of SE. corner sec. 14, T. 5 S., R. 30 E. (Maximal)	Moderately fine textured eolian sediments over hard caliche.	59-1586	8 to 13
		59-1587	13 to 18
		59-1588	18 to 24

See footnotes at end of table.

test data

with standard procedures of American Association of State Highway Officials (AASHO) (*1*)]

Horizon	Percentage passing sieve [1]— No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit [2]	Plasticity index [2]	Unified [3]	AASHO
Bl	100	99	27	NP	NP	SM	A–2–4(0).
B21	100	99	41	NP	NP	SM	A–4(1).
B22t	100	99	41	24	8	SC	A–4(1).
B2t	100	99	51	28	11	CL	A–6(4).
B3	100	99	42	26	10	SC	A–4(1).
Cca	100	65	36	30	11	SC	A–6(0).
B21t	100	100	44	27	10	SC	A–4(2).
B22t	100	100	44	31	13	SC	A–6(3).
B31	100	100	34	25	8	SC	A–2–4(0).
B1	100	100	35	NP	NP	SM	A–2–4(0).
B2t	100	100	48	26	NP	SM	A–4(3).
B31	100	100	50	25	8	SC	A–4(3).
B21t	100	100	49	26	8	SC	A–4(3).
B22t	100	100	51	28	11	CL	A–6(4).
B23	100	100	48	27	9	SC	A–4(3).
A1	100	100	53	22	5	ML–CL	A–4(4).
B21t	100	100	60	29	10	CL	A–4(5).
B22t	100	100	68	29	11	CL	A–6(7).
A12	100	99	18	NP	NP	SM	A–2–4(0).
B21t	100	99	30	25	8	SC	A–2–4(0)
B22t	100	99	37	29	13	SC	A–6(1).
B22t	100	98	66	33	12	CL	A–6(7).
B23	100	98	67	34	13	CL	A–6(8).
Cca	100	97	72	29	10	CL	A–4(7).
B1	100	99	52	25	8	CL	A–4(3).
B3cal	100	99	64	31	12	CL	A–6(7).
Ccal	100	99	58	28	10	CL	A–4(5).
B21	100	99	40	26	9	SC	A–4(1).
B3	100	99	37	26	8	SC	A–4(0).
Cca	100	98	55	26	10	CL	A–4(4).
A12	100	100	55	24	7	ML-CL	A–4(4).
B21t	100	100	62	33	11	ML-CL	A–6(6).
B3ca	[4] 14	13	8	36	15	GP-GC	A–2–6(0).
B21t	100	100	78	42	19	CL	A–7–6(12).
B22t	100	100	80	44	18	ML-CL	A–7–6(12).
B3ca	100	99	78	38	15	ML-CL	A–6(10).

TABLE 7.—*Engineering*

Soil name and location	Parent material	New Mexico report number	Depth
			Inches
Stegall loam, 0 to 1 percent slopes: 0.35 mile N. and 0.25 mile E. of SW. corner sec. 28, T. 4 S., R. 31 E. (Modal)	Moderately fine textured eolian sediments over hard caliche.	59–1580	2 to 5
		59–1581	5 to 10
		59–1582	10 to 17
Zita fine sandy loam, 0 to 1 percent slopes: 120 feet W. and 390 feet S. of pasture gate, sec. 6, T. 3 S., R. 32 E. (Modal)	Calcareous alluvial and eolian sediments.	60–2544	0 to 5
		60–2545	20 to 30
		60–2546	30 to 53

[1] Mechanical analysis according to AASHO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

Rough broken land and Riverwash are minor soils in this association and are the best locations in the county for sand and gravel pits. In some places there is little or no overburden to be removed.

Formation and Classification of Soils

This section explains the factors involved in soil formation, classifies the soils of the county by higher categories, and discusses the outstanding morphological characteristics of each soil series of Roosevelt County.

Factors of Soil Formation

Soil is a natural body, and thus a product of its environment. Those factors most influential in its development are parent material, climate, plant and animal life, relief, and time (*10*). It is possible that only one of these factors will have a dominant influence on the morphological characteristics of a particular soil. For example, relief has had a major effect on the development of the Potter soils. In other soils, such as the Amarillo and Olton, it is more difficult to single out any one of the five soil-forming factors as being dominant in their development. However, climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the development of distinct horizons.

Parent material

The soils of Roosevelt County, for the most part, developed in late Tertiary and Quaternary sediments laid down in late Pliocene and early Pleistocene times. In Recent geologic time, these sediments have been reworked by wind and water to form the basic material in which the soils developed.

The fact that this parent material differs in its physical characteristics is borne out by local terminology used to describe it. For example, the yellowish brown, medium-textured, strongly calcareous "High Plains marl" characterizes the parent material of the Amarillo and Clovis soils and marks the depth of their effective root zone. Light grayish-brown to white "soft caliche" describes the medium-textured or fine-textured alluvial sediments that underlie the Portales and Zita soils at a moderate depth.

The Potter and Mansker soils are shallow over High Plains marl and caliche rock. Fine-textured, residual, red-bed sediments, derived from red and blue shale and sandstone, are the parent material of the Montoya soils.

The Tivoli and Springer soils are the more youthful soils in the county and are eolian in origin. They are developing in coarse-textured, weakly calcareous or noncalcareous sediments of Recent geologic age. Because of the lack of clay, these soils show little, if any, horizon development either in structure or in texture.

The Spur soils, in the bottom of swales and drainageways, typify soils derived from recent alluvial sediments. These sediments, however, are washed from areas that are Tertiary in origin. They are strongly calcareous and are coarse textured to fine textured. Because these sediments are laid down by intermittent floodwaters that vary in velocity, the profile of the Spur soils typically is stratified.

It is evident, therefore, that parent material has a significant influence on the soil profile, particularly with regard to its chemical and mineralogical characteristics. Climate, plant and animal life, relief, and time are largely responsible for the presence or lack of either textural or structural horizons within the profile.

Climate

The climate of Roosevelt County has had a profound influence on soil formation. Prior to the present day semiarid climate, it is thought that the area experienced relatively long periods of alternate hot and dry, wet and cool

test data—Continued

Horizon	Percentage passing sieve [1]—			Liquid limit [2]	Plasticity index [2]	Unified [3]	AASHO
	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
A12	100	100	62	27	10	CL	A-4(5).
B1	100	99	64	35	14	CL	A-6(7).
B2t	100	99	71	41	19	CL	A-7-6(11).
A1	100	99	48	20	5	SM-SC	A-4(3).
Cca	100	99	60	34	13	CL.	A-6(6).
C	100	99	35	23	5	SM-SC	A-2-4(0).

[2] NP in column means nonplastic.
[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification.
[4] 100 percent passes the 3-inch sieve, and 15 percent passes the No. 4 sieve.

climatic cycles.[5] The formation of caliche horizons, both friable and indurated, are believed to have been the result of these changes in climate. In Recent geologic time, the area has experienced a semiarid climate conducive to the growth of mid- and short-grass types of vegetation. The upward movement of lime through the relatively shallow root system and the shallow-leaching effect of limited rainfall have created prominent Cca horizons at a moderate depth within the soil profile, particularly in the finer textured soils.

Wind also has had considerable influence on the soils of the county. The Kimbrough and Arvana soils, for example, developed in a relatively thin, fine-textured or medium-textured loessal mantle overlying indurated caliche. On the other extreme, the Brownfield, Springer, and Tivoli soils developed in coarse-textured Tertiary deposits that were reworked by wind and through which water moves rapidly. Consequently, Cca horizons are lacking or commonly are deeper in these soils than in the finer textured soils.

Because of the normally hot-dry climate of the area, the soils are low in organic matter and are highly oxidized, which accounts for their dominant red color.

Relief

The relief, or topography, as a factor in the formation of the soils of Roosevelt County is most apparent on slopes around playas and along drainageways. On such slopes, runoff is more rapid and erosion more pronounced. Thus, the prevailing soil climate is altered, and normal soil development is restricted. The shallow soils of the county, such as Mansker and Potter, exemplify this effect of relief on soil development. In contrast, the deeper soils, such as the Amarillo, Clovis, and Olton, commonly are in the more nearly level areas and are more strongly developed.

[5] ROBBINS, H. WESTON, THE PLEISTOCENE GEOLOGY OF THE PORTALES VALLEY, ROOSEVELT COUNTY, AND CERTAIN ADJACENT AREAS. July, 1941. [Unpublished thesis.]

Plant and animal life

The influence of plant and animal life on soil development is closely linked to the climate. The climate in the county supports grass-type vegetation. Organic staining from decay of this vegetation is visible on the peds of the more strongly developed soils. On such soils as the Tivoli, it commonly is the only evidence of the thin, weak A horizon. The porosity, structure, and general tilth of the soils are directly related to the degree of activity of micro-organisms, fungi, worms, rodents, and wildlife on the surface and within the soil profile.

Time

In considering time as a factor of soil formation, one is tempted to use the terms time and age synonymously in setting up a chronological sequence for the soils of the county. In taking this viewpoint, it must be assumed that all of the other factors of soil formation have exerted an equal influence on the development of the soils. It would then follow that the time factor in the development of soil profiles could be evaluated by measuring the depth of leaching; by analyzing the degree of structural development; and by checking the thickness and continuity of clay films, the consistency of the soil peds, and the thickness and color of the soil horizons.

Using these criteria, a chronological sequence for the soils that developed in Tertiary outwash sediments would begin with Olton and progress through the Amarillo, Clovis, Springer, Brownfield, and Tivoli. For those soils that developed over indurated caliche, the sequence perhaps would be the Arvana, Kimbrough, Mansker, and Potter. The more youthful soils would be those developing in alluvial sediments, and the sequence would be the Zita, Portales, Arch, Spur, and Montoya.

Unfortunately such a chronological order for the soils of the county is not a true correlation. The factors of parent material, relief, climate, and plant and animal life have not exerted their influence equally or universally over the soils of the county. Nevertheless, it does serve to

show the importance of time in the role of soil formation. Time has exerted an immeasurable influence upon the depth of leaching, soil structure, consistency, and color.

Classification of Soils

Soils are placed in narrow classes for the organization and application of knowledge about their behavior within farms, ranches, or counties. They are placed in broad classes for study and comparisons of large areas such as continents. In the comprehensive system of soil classification followed in the United States (*9*), the soils are placed in six categories. Beginning with the most inclusive, these categories are order, suborder, great soil group, family, series, and type.

There are three soil orders, whereas there are thousands of soil types. The suborder and family categories have not been fully developed and, thus, have been little used. Attention has been given largely to classification of soils into great soil groups, series, and types.

Soil orders and great soil groups

The three orders are the zonal, the intrazonal, and the azonal. The zonal order consists of soils that have evident, genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. The intrazonal order consists of soils that have evident, genetically related horizons that reflect the dominant influence of one or more local factors—topography or parent material—over the effects of climate and living organisms. The azonal order consists of soils that lack distinct, genetically related horizons commonly because of youth, resistance of parent material to change, or steep topography.

In the following list, the soil series of Roosevelt County are classified by orders and by great soil groups. Following the list is a discussion of the soil orders and great soil groups represented in the county.

ZONAL ORDER—
- Reddish Chestnut soils:
  - Amarillo
  - Arvana
  - Clovis
  - Olton
- Chestnut soils:
  - Bippus
  - Stegall
  - Zita
- Reddish brown soils:
  - Brownfield
  - Springer

INTRAZONAL ORDER—
- Calcisols:
  - Arch
  - Gomez
  - Mansker
  - Portales
- Planosols:
  - Blackwater

AZONAL ORDER—
- Alluvial soils:
  - Montoya
  - Spur
- Lithosols:
  - Kimbrough
  - Potter
  - Travessilla
- Regosols:
  - Berthoud
  - Church [1]
  - Drake
  - Tivoli

[1] Intergrading to Low-Humic Gley.

ZONAL ORDER

Zonal soils are represented in Roosevelt County by the Reddish Chestnut, Chestnut, and Reddish Brown great soil groups. The uppermost layers of these soils are leached of lime, and there is a weak to moderate accumulation of clay in the subsoil.

The Reddish Chestnut great soil group is represented in the county by the Amarillo, Arvana, Clovis, and Olton soils. These soils are deep or moderately deep over a zone of accumulated lime. Their surface layer ranges from brown to reddish brown, and there is a moderate accumulation of clay in the subsoil.

The Chestnut great soil group is represented in the county by the Bippus, Stegall, and Zita soils. These soils are moderately deep over a zone of accumulated lime. In the Bippus soils, the lime is nodular; in the Stegall, it is indurated; and in the Zita, it is soft and prominent. The surface layer of these soils ranges from dark grayish brown to brown; the surface layer and upper part of the subsoil are leached; and the subsoil contains a moderate accumulation of clay. The Bippus and Zita soils are less strongly developed than the soils of the Reddish Chestnut great soil group.

The Reddish Brown great soil group is represented in the county by the Brownfield and Springer soils. These soils are sandier than the other zonal soils in the county, and they are leached to a greater depth. They have only a slight accumulation of clay in the subsoil, and the calcareous layer generally occurs at a depth of more than 5 feet.

INTRAZONAL ORDER

Intrazonal soils are represented in Roosevelt County by the Calcisol and Planosol great soil groups. These soils occur in concave areas or in valleys. Climate and parent material, in addition to relief, have been important in their development.

The Calcisol great soil group is represented in the county by the Arch, Gomez, Mansker, and Portales soils. Except for the Gomez soils, which commonly are leached of lime in the uppermost 10 to 12 inches, these soils are calcareous throughout the profile. They are young soils and have only weak horizonation or profile development. There is little, if any, accumulation of clay in the subsoil. A zone of accumulated lime generally occurs at a depth of less than 20 inches.

The Planosol great soil group is represented in the county by the Blackwater soils. These soils are finer textured, darker colored (grayish brown), and more strongly developed than the other intrazonal soils in the county. They developed in low wet places along streams, and they have accumulated clay in the subsoil. The subsoil rests abruptly on an indurated caliche layer at a depth of 20 to 36 inches.

AZONAL ORDER

Azonal soils are represented in Roosevelt County by the Alluvial, Lithosol, and Regosol great soil groups. These soils show no profile development or only weak profile development. They have a light grayish-brown to light reddish-brown surface layer, and they have little or no accumulation of clay in the subsoil.

The Alluvial great soil group is represented in the county by the Montoya and Spur soils. The Montoya soils developed in alluvial red-bed sediments and are fine textured. The Spur soils developed in alluvium derived from Tertiary sediments and are moderately fine textured. The soils of this group range from reddish brown to dark brown in color and show little evidence of movement of clay into the subsoil.

The Lithosol great soil group is represented in the county by the Kimbrough, Potter, and Travessilla soils. These soils are mostly gently sloping to strongly sloping. They are shallow or very shallow and have only weak

horizon development. The Kimbrough soils show some evidence of the movement of clay into a thin subsoil.

The Regosol great soil group is represented in the county by the light-colored and shallow Berthoud, Church, Drake, and Tivoli soils. Except for the Church soils, these soils occur in gently sloping to moderately steep areas. They have no marked horizons and show no evidence of movement of clay. The Church soils are intergrades to Low-Humic Gley soils. They occur in level areas around playas. They are weakly developed and have a strongly calcareous subsoil.

Soil series

Following is a brief description of each soil series in the county and a detailed description of a representative profile of each series.

AMARILLO SERIES

The Amarillo series consists of deep, moderately permeable, Reddish Chestnut soils that developed in medium-textured or coarse-textured Tertiary sediments, which commonly have been reworked by wind. The noncalcareous, reddish-brown surface layer is about 10 inches thick and has weak to moderate, fine, granular structure. The noncalcareous B horizon is about 40 inches thick and is similar to the surface layer in color. It has moderate to strong, medium to coarse, prismatic structure that, in the lower part, breaks to moderate, medium, subangular blocky structure. This horizon is typically sandy clay loam and overlies a zone of white to yellowish-red High Plains marl or caliche. The caliche limits the depth of the effective root zone.

The Amarillo soils are extensive in the county. They occur on the level or gently sloping uplands, where they are associated with the Clovis and Arvana soils. They have a thicker, more strongly developed B horizon than the Clovis soils. Their B horizon resembles the B horizon of the Arvana soils in structure and in texture, but the Amarillo soils lack the dense, indurated caliche layer that occurs at a moderate depth in the Arvana soils.

Profile of Amarillo loamy fine sand, 0.05 mile west of the southeast corner of sec. 27, T. 1 S., R. 31 E.

A11—0 to 2 inches, reddish-brown (5YR 5/4) loamy fine sand, dark reddish brown (5YR 3/4) when moist; single grain; loose when dry or moist, nonsticky when wet; numerous roots; noncalcareous; abrupt boundary.

A12–2 to 6 inches, reddish-brown (5YR 4/4) loamy fine sand, dark reddish brown (5YR 3/3) when moist; weak, very fine, granular structure; loose when dry, very friable when moist, nonsticky when wet; few dark organic stains; numerous roots; noncalcareous; clear, smooth boundary.

A13—6 to 10 inches, reddish-brown (5YR 4/4) loamy fine sand, dark reddish brown (5YR 3/3) when moist; weak, medium, subangular block structure breaking to weak, very fine, granular structure; loose when dry, very friable when moist, nonsticky when wet; numerous roots; noncalcareous; clear boundary.

B1—10 to 17 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; strong, coarse, prismatic structure; slightly hard when dry, friable when moist, slightly sticky when wet; numerous roots, numerous small and large pores; noncalcareous; clear, smooth boundary.

B21t—17 to 29 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; strong, coarse, prismatic structure; hard when dry, friable when moist, sticky when wet; numerous small and large pores; few organic stains; noncalcareous; clear, smooth boundary.

B22t—29 to 44 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, coarse, prismatic structure; hard when dry, friable when moist, sticky when wet; few roots; thin patchy clay films; numerous small and large pores; few small krotovinas; noncalcareous; abrupt, wavy boundary.

B3ca—44 to 51 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; few roots; large krotovinas; caliche-coated quartz pebbles; strongly calcareous; gradual, smooth boundary.

C1ca—51 to 72 inches, white to pink (10YR 8/2 to 5YR 7/3) weakly indurated caliche, pink to reddish yellow (5YR 7/4 to 6/6) when moist; strongly calcareous; abrupt, broken boundary.

C2ca—72 to 82 inches, light reddish-brown (5YR 6/4) silty clay loam, yellowish red (5YR 5/6) when moist; 50 to 70 percent caliche by volume; somewhat less indurated than C1ca horizon; few caliche-coated igneous pebbles; strongly calcareous.

The surface layer ranges from 8 to 12 inches in thickness. The color of the A and B horizons ranges from 7.5YR to 5YR in hue, from 4 to 6 in value, and from 3 to 4 in chroma. In places the depth to the Cca horizon is as little as 36 inches.

ARCH SERIES

The Arch series consists of shallow soils that developed in chalklike caliche material derived from wind-reworked lacustrine sediments of late Pleistocene age. These soils are in the Calcisol great soil group. They are extensive in the Portales irrigated area but occur to a lesser extent throughout the rest of the county.

The Arch soils occupy smooth to gently sloping terrain in association with Church and Zita soils. They are more shallow and limy than Zita soils and not so fine textured as Church soils. They have a lighter colored surface layer than Zita or Church soils.

Profile of Arch loam, 1,500 feet south and 100 feet west of the northeast corner of sec. 2, T. 3 S., R. 36 E.

A1—0 to 6 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, granular structure to weak, medium, subangular blocky structure; soft when dry, very friable when moist, slightly sticky when wet; calcareous; clear boundary.

C1ca—6 to 14 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak, medium to coarse, prismatic structure; slightly hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; some visible concretions of secondary calcium carbonate; clear boundary.

C2ca—14 to 36 inches, light-gray (10YR 7/1) clay loam, light brownish gray (10YR 6/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky or sticky when wet; strongly calcareous; visible concretions of secondary calcium carbonate; gradual boundary.

C3ca—36 inches+, white (10YR 8/1) clay loam, pale yellow (2.5Y 8/4) when moist; many, distinct, yellow mottles; massive; slightly hard when dry, very friable when moist, slightly plastic when wet; strongly calcareous.

The surface layer ranges from about 4 to 14 inches in thickness and from 7.5YR to 10YR in hue, from 5 to 6 in value, and from 2 to 3 in chroma. The Cca horizon occurs at a depth of 6 inches or more. Under cultivation the weak structure in the upper part of the C horizon generally is destroyed.

ARVANA SERIES

The Arvana series consists of moderately deep, moderately permeable Reddish Chestnut soils that developed in medium-textured or moderately fine textured, late Tertiary sediments that have been reworked by wind.

The surface layer is about 8 inches thick and typically is brown to reddish brown in color. It has weak, fine, granular structure. The B horizon is about 18 to 20 inches of reddish-brown to yellowish-red sandy clay loam. It has moderate to strong prismatic structure and rests abruptly on a layer of indurated caliche. The dense, indurated caliche layer occurs at a depth of 26 to 28 inches and limits the depth of the root zone.

The Arvana soils are intermixed with the Amarillo and Clovis soils but commonly occur in association with the Kimbrough and Potter soils. They are deeper than either the Kimbrough or the Potter soils.

Profile of the Arvana fine sandy loam in the SW¼ NW¼ sec. 17, T. 1 S., R. 34 E.

A1—0 to 8 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/2) when moist; weak, fine, granular structure; soft when dry, friable when moist, slightly sticky when wet; abundant roots; many root channels and worm casts, several small pores; noncalcareous; abrupt, broken boundary.

B21t—8 to 16 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/3) when moist; strong, coarse, prismatic structure; hard when dry, friable when moist, sticky when wet; few quartz pebbles; many roots, many worm casts; noncalcareous; gradual, smooth boundary.

B22t—16 to 22 inches, yellowish-red (5YR 4/6) sandy clay loam, dark reddish brown (5YR 3/4) when moist; strong, coarse, prismatic structure; hard when dry, friable when moist, sticky when wet; few roots; thin patchy clay films; several small and large pores; noncalcareous; clear, smooth boundary.

B3—22 to 27 inches, yellowish-red (5YR 4/6) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, coarse, prismatic structure; hard when dry, friable when moist, sticky when wet; few roots; many worm casts; noncalcareous; clear, smooth boundary.

B3ca—27 to 28 inches, yellowish-red (5YR 5/6) sandy clay loam, dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist, sticky when wet; strongly calcareous; few soft and hard concretions of calcium carbonate; abrupt boundary.

IIR—28 inches +, white to pink (7.5YR 8/0 to 5YR 8/3) indurated caliche, pink to light gray (5YR 7/3 to 7.5YR 7/0) when moist.

The thickness of the surface layer ranges from 3 to 12 inches. The color of the A and B horizons ranges from 5YR to 7.5YR in hue, from 3 to 5 in value, and from 3 to 6 in chroma. The depth to indurated caliche ranges from 12 inches in the shallow phase to 20 to 36 inches in the other soils.

BERTHOUD SERIES

The Berthoud series consists of deep, dark-brown, well-drained, moderately permeable soils that developed in strongly calcareous alluvial sediments derived from sedimentary and Ogallala parent material. These soils are in the Regosol great soil group. They occur in the northern and western parts of the county and are associated with the Mansker and Potter soils.

The surface layer is about 8 inches thick and is moderately coarse textured. The AC horizon has weak, subangular blocky structure and is underlain by a weak but evident Cca horizon. Some caliche-coated, igneous pebbles occur throughout the profile.

Profile of Berthoud sandy loam in the NW¼SE¼ sec. 7, T. 3 N., R. 30 E.

A1—0 to 8 inches, brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) when moist; weak, granular structure; soft when dry, very friable when moist, nonsticky when wet; calcareous; some medium or coarse pebbles; clear boundary.

AC—8 to 18 inches, light-brown (7.5YR 6/4) loam, strong brown (7.5YR 5/6) when moist; weak, coarse, subangular blocky structure; soft when dry, friable when moist, slightly sticky when wet; some medium or coarse pebbles; strongly calcareous; abrupt boundary.

Cca—18 inches +, pink (7.5YR 7/4) very fine sandy loam, strong brown (7.5YR 5/6) when moist; structureless; slightly hard when dry, friable when moist, slightly sticky when wet; strongly calcareous; few fine pebbles.

The thickness of the A horizon ranges from 4 to 12 inches. The color of the A horizon ranges from 7.5YR to 10YR in hue, from 4 to 5 in value, and from 4 to 6 in chroma. The depth to the Cca horizon ranges from 12 to 20 inches.

BIPPUS SERIES

The Bippus series consists of dark-colored, well-drained, moderately permeable Chestnut soils that developed in moderately fine textured, calcareous sediments. These soils occur on low-lying alluvial and colluvial slopes along large drainageways in the western part of the county. They are associated with the Spur and Berthoud soils but are darker colored than either of these soils.

The surface layer, which is about 7 inches thick, is leached of lime. It rests clearly on the calcareous A12 horizon, which is about 6 inches thick. A weak but evident Cca horizon occurs at a moderate depth. It is about 30 inches thick and contains prominent deposits of calcium carbonate.

Profile of Bippus clay loam in the SW¼SE¼ sec. 21, T. 1 N., R. 31 E.

A11—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, dark brown (10YR 3/3) when moist; weak to moderate, very fine, granular structure; hard when dry, very friable when moist; noncalcareous; clear, smooth lower boundary.

A12—7 to 13 inches, brown or dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/3) when moist; very weak, coarse, prismatic structure breaking to weak, moderate, subangular blocky structure; hard when dry, very friable when moist; weakly calcareous; clear, smooth lower boundary.

Cca—13 to 42 inches, brown (7.5YR 5/3) sandy clay loam, brown to dark brown (7.5YR 4/3) when moist; massive; hard when dry, very friable when moist; strongly calcareous; small deposits of accumulated calcium carbonate.

The surface layer ranges from 4 to 10 inches in thickness. The color ranges from 7.5YR to 10YR in hue, from 3 to 5 in value, and from 2 to 4 in chroma. Depth to the Cca horizon ranges from 12 to 30 inches.

BLACKWATER SERIES

The Blackwater series is made up of grayish-brown, moderately deep soils that occur in slightly concave areas. These soils occupy a rather limited acreage in the Portales irrigated area. They are the only member of the Planosol great soil group in the county.

The surface layer is 4 or 5 inches of loam. It overlies a thin, bleached A2 horizon. The B horizon is clay and is about 13 inches thick. It has strong to moderate structure and rests abruptly on indurated caliche.

Profile of Blackwater loam in the SW¼SE¼ sec. 20, T. 1 S., R. 34 E.

Alp—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; very weak, medium, subangular blocky structure breaking to moderate, fine, granular structure; hard when dry, friable when moist; noncalcareous; clear, smooth lower boundary.

A2—5 to 9 inches, light-gray (10YR 7/2) clay, grayish brown (10YR 5/2) when moist; weak, thin, platy structure; slightly hard when dry, very friable when moist; few, small, faint, dark yellowish-brown mottles; noncalcareous; abrupt, smooth lower boundary.

B2t—9 to 17 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure breaking to strong, fine, angular blocky structure; extremely hard when dry, very firm when moist; thick, continuous clay films; some cracks between structural aggregates contain materials that have sifted down from the horizons above; noncalcareous; gradual, smooth lower boundary.

B3cag—17 to 22 inches, variegated horizons, grayish-brown (2.5Y 5/2) and olive (5Y 5/3) clay, dark grayish brown and olive (2.5Y 4/2) (5Y 4/3) when moist; moderate, medium and fine, subangular block structure; very hard when dry, firm when moist; thick, continuous clay films; few, faint, brown mottles; calcareous; few, small, soft concretions of calcium carbonate; abrupt boundary.

IIR—22 inches+, hard indurated caliche beds.

In cultivated areas, the A2 horizon may be destroyed. The texture of the Alp horizon ranges from loam to sandy clay loam. The depth to the IIR horizon ranges from 14 to 24 inches.

BROWNFIELD SERIES

The Brownfield series consists of leached, coarse-textured, Reddish Brown soils that developed in wind-reworked Pleistocene or late Tertiary sediments of the Southern High Plains.

The surface layer is about 20 inches of fine sand to loamy fine sand. It is underlain abruptly by the sandy clay loam B horizon. The B horizon is 25 to 48 inches thick, has coarse prismatic structure, is noncalcareous, and typically is more red than the surface layer.

The Brownfield soils are extensive in the southern part of the county, and they support much of the shin-oak vegetation common in that area. They occur in smoother, less dunelike areas than the associated sandy Tivoli soils.

Profile of Brownfield fine sand, ¼ mile east and 1,000 feet north of the southwest corner of sec. 32, T. 2 S., R. 33 E.

A11—0 to 2 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; weak, platy structure; loose when dry or moist, nonsticky when wet; noncalcareous; abrupt boundary.

A12—2 to 15 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; very weak, granular structure; loose when dry or moist, nonsticky when wet; noncalcareous; gradual boundary.

A3—15 to 23 inches, reddish-brown (5YR 5/4) loamy fine sand, yellowish red (5YR 4/6) when moist; massive to weak, coarse, granular structure; slightly hard when dry, very friable when moist, nonsticky when wet; noncalcareous; abrupt boundary.

B21t—23 to 33 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, coarse, prismatic structure; hard or very hard when dry, friable when moist, slightly sticky or slightly plastic when wet; noncalcareous; clear boundary.

B22t—33 to 50 inches, reddish-brown (2.5YR 4/4) sandy clay loam, yellowish red (5YR 4/8) when moist; moderate, coarse, prismatic structure; very hard when dry, friable when moist, slightly sticky or plastic when wet; thin patchy clay films; noncalcareous; gradual boundary.

B3—50 to 64 inches, red (2.5YR 4/6) sandy clay loam, yellowish red (5YR 5/8) when moist; weak, coarse, prismatic structure; hard when dry, very friable when moist, slightly sticky when wet; noncalcareous; clear boundary.

C1—64 to 97 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; massive; hard when dry, very friable when moist, slightly sticky when wet; noncalcareous; gradual boundary.

C2ca—97 to 113 inches+, reddish-yellow (5YR 6/8) loam, yellowish-red (5YR 4/8) when moist; massive; hard when dry, friable when moist, slightly sticky or sticky when wet; strongly calcareous; prominent lime mycelia; numerous small concretions of caliche 5 to 10 millimeters in size.

The A11 horizon is lacking in some profiles. The A horizon ranges from 16 to 28 inches in thickness but generally is about 20 inches thick. The surface layer ranges from 5YR to 7.5YR in hue, from 4 to 6 in value, and from 4 to 5 in chroma. The depth to the Ca horizon ranges from 48 inches to as much as 10 feet, but commonly is about 97 inches.

CHURCH SERIES

The Church series consists of slowly drained, clayey soils that developed in the lacustrine sediments of small lake basins. These soils are classified as Regosols intergrading to Low-Humic Gley soils. They developed under conditions of poor drainage and have light-gray or light brownish-gray to pale-brown, fine-textured, compact C horizons.

The Church soils are similar to the Arch and Drake soils but are finer textured than either. They generally occur at lower elevations in the lake basins than do the Arch soils.

Profile of Church clay loam in the NW¼NE¼ sec. 11, T. 1 S., R. 32 E.

A—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, granular structure; slightly hard when dry, very friable when moist, slightly sticky or plastic when wet; strongly calcareous; abrupt boundary.

C1ca—7 to 15 inches, light-gray (10YR 7/2) clay, light brownish gray (10YR 6/2) when moist; weak, coarse, subangular blocky structure; very hard when dry, firm when moist, sticky or very plastic when wet; numerous medium pores; strongly calcareous; gradual boundary.

C2ca—15 to 27 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; massive; very hard when dry, firm when moist, sticky or very plastic when wet; few medium to fine pores; few concretions of soft calcium carbonate; strongly calcareous; gradual boundary.

C3ca—27 to 37 inches, light-gray (2.5Y 7/2) silty clay, olive yellow (2.5Y 6/6) when moist; massive; hard when dry, firm when moist, sticky or plastic when wet; few coarse pores; few concretions of soft calcium carbonate; strongly calcareous; abrupt boundary.

The surface layer ranges from 10YR to 2.5Y in hue, from 3 to 5 in value, and from 1 to 2 in chroma. The C horizon ranges from 2.5Y to 5Y in hue and in places is stratified with sand.

CLOVIS SERIES

The Clovis series consists of moderately deep, moderately permeable, Reddish Chestnut soils that developed in

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Tertiary sediments that in some places have been modified by wind. These soils are extensive on gently sloping uplands throughout the county.

The surface layer is dark brown in color, noncalcareous, and about 6 inches thick. The B horizon, which is about 24 inches thick, is noncalcareous in the upper part but is increasingly calcareous with depth.

The Clovis soils are similar to the Amarillo soils in color and in texture, but they have thinner, less strongly developed horizons.

Profile of Clovis loam in the NW¼SW¼ sec. 19, T. 2 S., R. 30 E.

A11—0 to 2 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 4/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; abundant roots; noncalcareous; abrupt boundary.

A12—2 to 5 inches, dark-brown (7.5YR 4/3) loam, dark brown (7.5YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, granular structure; soft when dry, friable when moist, slightly sticky when wet; abundant roots; few pores; noncalcareous; clear, gradual, smooth boundary.

B1—5 to 14 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist, slightly sticky when wet; abundant roots; thin clay films on sand grains; numerous large pores; noncalcareous; clear, smooth boundary.

Bt2—14 to 18 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak to moderate, medium, prismatic structure; slightly hard when dry, friable when moist, sticky when wet; few roots; thin patchy clay films on surface of peds; few large and small pores; noncalcareous; clear, smooth boundary.

B31ca—18 to 26 inches, reddish-brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist, sticky when wet; few roots; numerous large and small pores; strongly calcareous; clear, wavy boundary.

B32ca—26 to 32 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist, sticky when wet; few small roots; numerous fine pores; strongly calcareous; clear, wavy boundary.

Cca—32 to 50 inches, pink (5YR 7/4) clay loam, reddish yellow (5YR 7/6) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, sticky when wet; few medium pores; strongly calcareous; clear, wavy boundary.

The surface layer ranges from 4 to 10 inches in thickness, and the subsoil from 14 to 26 inches. The color ranges from 5YR to 7.5YR in hue, from 3 to 5 in value, and from 3 to 4 in chroma.

DRAKE SERIES

The Drake series consists of calcareous Regosols that occur on the lee side of intermittent lake basins throughout the county. The total acreage is not large. These soils developed in eolian sediments that were blown from the lacustrine deposits of the lake basins.

Typically, the Drake soils have an AC profile and are strongly calcareous throughout. The surface layer is pale-brown fine sandy loam or loam. It is underlain by the light-gray loam to clay loam parent material, which is several feet thick. These soils have little horizonation other than a pale-brown surface horizon.

Profile of Drake fine sandy loam, 1,800 feet south and 200 feet west of the northeast corner of sec. 14, T. 2 S., R. 35 E.

A1—0 to 8 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky when wet; strongly calcareous; gradual boundary.

C1—8 to 19 inches, light-gray (10YR 7/2) loam, light brownish gray (10YR 6/2) when moist; massive; soft when dry, very friable when moist, nonsticky when wet; strongly calcareous; gradual boundary.

C2—19 to 60 inches, light-gray (10YR 7/2) light silty clay loam, light yellowish brown (10YR 6/4) when moist; massive; slightly hard when dry, friable when moist, sticky when wet; strongly calcareous.

In many profiles the silt content is greater than that described. The surface layer ranges from 6 to 12 inches in thickness, and in places it has weak, platy structure in the uppermost 2 to 4 inches.

GOMEZ SERIES

The Gomez series consists of coarse-textured Calcisols that developed in light-colored, alluvial lacustrine sediments. These soils are noncalcareous or weakly calcareous in the uppermost 10 or 12 inches, and they show little, if any, structural development.

Internal drainage is good, and the substratum generally is moist, but root development is limited to the layers above the calcareous parent sediments.

These soils are associated with Arch loamy fine sand, which is more limy in the surface layer and is shallower to the underlying lime zone.

Profile of Gomez loamy fine sand, 3/10 mile west and 350 feet south of the northeast corner of sec. 1, T. 1 S., R. 34 E.

A1—0 to 4 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist, nonsticky when wet; noncalcareous; abrupt to clear boundary.

AC—4 to 12 inches, brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) when moist; single grain to massive; soft when dry, loose when moist, nonsticky when wet; very coarse; few lime concretions; noncalcareous; clear boundary.

C1ca—12 to 22 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; very weak, subangular blocky structure; soft when dry, very friable when moist, slightly sticky when wet; strongly calcareous; abrupt boundary.

C2ca—22 inches +, gray (2.5Y 6/0) loam; massive; slightly hard when dry, friable when moist, nonsticky or slightly sticky when wet; strongly calcareous.

The surface layer ranges from 7.5YR to 10YR in hue; from 3 to 4 in value; and from 2 to 4 in chroma. In places the profile is calcareous throughout.

KIMBROUGH SERIES

The Kimbrough series consists of very shallow Lithosols that developed over beds of dense, indurated caliche similar in degree of hardness to the caliche underlying the Arvana soils. The layer of indurated caliche restricts the movement of water and limits the depth of the root zone.

These soils occur in nearly level areas, where they are associated with the shallow Arvana soils. They are more shallow than the Arvana soils, and they lack a developed B horizon.

Profile of Kimbrough loam, northeast corner of sec. 18, T. 4 S., R. 30 E.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate to strong, coarse, granular structure; slightly hard when dry, friable when moist, sticky when wet; noncalcareous; clear boundary.

A12—2 to 8 inches, brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 4/2) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist, sticky or slightly plastic when wet; noncalcareous to slightly calcareous in lower part; abrupt boundary.

IIR—8 inches+, indurated caliche; laminated surface.

The surface layer ranges from 7.5YR to 10YR in hue, from 4 to 6 in value, and from 2 to 3 in chroma. The texture of the A12 horizon ranges from a sandy clay loam to light silty clay loam.

MANSKER SERIES

The Mansker series consists of shallow to moderately deep soils that developed in strongly calcareous Tertiary sediments. These soils occur in level to gently sloping areas on the High Plains. They are one of the major soils of the Calcisol great soil group in Roosevelt County.

The surface layer ranges from 4 to 8 inches in thickness and from loam to fine sandy loam in texture. The AC horizon, which is about 6 to 12 inches thick, is weakly developed and is underlain by a strong lime zone that contains caliche gravel.

The Mansker soils are thicker than the Potter soils, and they lack the textural B horizon, which is characteristic of the Clovis soils.

The Mansker soils do not form stable aggregates and are easily damaged by wind.

Profile of Mansker loam in the SE¼NE¼ sec. 27, T. 1 S., R. 31 E.

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, dark brown (10YR 3/3) when moist; medium, fine, granular structure; soft when dry, friable when moist, slightly sticky or slightly plastic when wet; strongly calcareous; clear boundary.

AC—5 to 17 inches, brown (10YR 5/3) loam, brown (10YR 4/3) when moist; weak, medium to coarse, granular structure to massive; slightly hard when dry, friable when moist, slightly sticky or slightly plastic when wet; strongly calcareous; gradual boundary.

Cca—17 inches+, very pale brown (10YR 7/3) gravelly loam, yellowish brown (10YR 5/4) when moist; numerous concretions of white, fine, medium, and coarse, slightly indurated lime; loose when dry, sticky when wet; strongly calcareous.

The surface layer ranges from 4 to 8 inches in thickness and from 7.5YR to 10YR in hue, from 3 to 5 in value, and from 2 to 4 in chroma. The AC horizon ranges from 6 to 12 inches in thickness. The depth to the Cca horizon ranges from 10 to 20 inches.

MONTOYA SERIES

The Montoya series consists of reddish-brown Alluvial soils that have a moderately fine textured surface horizon and a fine textured subsoil. These soils developed in alluvium derived from red-bed shale. They occur in smooth, gently sloping valleys adjacent to red-bed escarpments or outcrops. Small areas occur in the vicinity of Red Lake and other areas are near Kenna, which is in the southwestern part of the county. The total acreage is small.

The Montoya soils have a fine-textured C horizon that in places is underlain at a depth of more than 48 inches by partially weathered shale. They are finer textured and redder than the Spur soils.

Profile of Montoya clay loam in the NE¼SE¼ sec. 24, T. 5 S., R. 30 E.

A1—0 to 13 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, coarse, subangular blocky structure breaking to moderate, fine, granular structure; slightly hard when dry, firm when moist, plastic or sticky when wet; strongly calcareous; clear boundary.

C1—13 to 30 inches, dark reddish-brown (5YR 3/3) silty clay, dark reddish brown (5YR 3/4) when moist; weak, coarse, subangular blocky structure; very hard when dry, firm when moist, plastic or sticky when wet; strongly calcareous; diffuse boundary.

C2—30 to 60 inches, reddish-brown (2.5YR 5/4) silty clay, reddish brown (2.5YR 4/5) when moist; massive; very hard when dry, friable when moist, plastic or sticky when wet; numerous fragments of weathered shale below a depth of 48 inches; strongly calcareous.

The surface layer ranges from 5 to 14 inches in thickness and from 2.5Y to 5YR in hue, from 3 to 5 in value, and from 3 to 5 in chroma.

OLTON SERIES

The Olton series consists of deep Reddish Chestnut soils that have a moderately fine textured subsoil. These soils developed in Pleistocene sediments on the southern High Plains. They occur mostly on slightly concave slopes in the east-central part of the county. They are associated with the Amarillo, Portales, and Mansker soils but are finer textured and more strongly developed than those soils.

The surface layer is loam and is about 4 inches thick. The B horizon is clay loam or sandy clay loam and is about 24 inches thick.

The Olton soils are not extensive in the county. Only about a third of the acreage is cultivated.

Profile of Olton loam in the NE¼NW¼ sec. 25, T. 3 S., R. 36 E.

Ap—0 to 4 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; strong, coarse, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear boundary.

B1—4 to 8 inches, brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/2) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; noncalcareous; clear boundary.

B22t—8 to 13 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/2) when moist; moderate, prismatic structure to moderate, medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; gradual boundary.

B3—13 to 28 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous or slightly calcareous; abrupt boundary.

C1ca—28 to 46 inches, light reddish-brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) when moist; massive; strongly calcareous; numerous concretions of white, soft calcium carbonate; clear boundary.

C2—46 to 60 inches, pink (5YR 8/3) silt loam, light reddish brown (5YR 6/4) when moist; massive; strongly calcareous.

The A horizon ranges from 4 to 8 inches in thickness, and the B horizon, from 12 to 30 inches. The color of the A horizon ranges from 5YR to 7.5YR in hue. The depth to the Cca horizon ranges from 18 to 36 inches.

PORTALES SERIES

The Portales series consists of grayish-brown Calcisols that occur mainly in the Portales irrigated area in association with the shallow Arch soils. Elsewhere in the county, they occur in concave areas in association with the Mansker and Clovis soils.

The Portales soils are underlain at a moderate depth by a light-colored Cca horizon comprised of alluvial sediments. This layer limits the depth of the effective root zone. The Cca horizon is similar to that of the Arch soils, but it occurs at a greater depth.

Profile of Portales loam in the SW¼NE¼SE¼ sec. 24, T. 1 S., R. 33 E.

A1p—0 to 8 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft or slightly hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; abrupt, smooth boundary.

AC—8 to 22 inches, grayish-brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, fine, granular structure; slightly hard when dry, friable when moist, sticky when wet; strongly calcareous; gradual boundary.

C1ca—22 to 27 inches, light-gray (10YR 7/2) sandy clay loam, grayish brown (10YR 5/2) when moist; moderate, coarse, granular structure; strongly calcareous; concretions of calcium carbonate in the lower part; clear, smooth boundary.

C2ca—27 to 60 inches, light-gray (10YR 7/1) loam, very pale brown (10YR 8/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky when wet; strongly calcareous.

The surface layer ranges from 4 to 10 inches in thickness and from 10YR to 7.5YR in hue, from 4 to 5 in value, and from 2 to 4 in chroma. The AC horizon ranges from 10 to 16 inches in thickness and from loam to sandy clay loam in texture. The depth to the Cca horizon ranges from 20 to 36 inches.

POTTER SERIES

The Potter series consists of medium-textured or moderately coarse textured Lithosols that developed in thin, strongly calcareous parent material overlying beds of broken, hard caliche. These soils are closely associated with the Kimbrough and Mansker soils. They differ from the Kimbrough soils in being strongly calcareous and in having stronger slopes. They are similar to the Mansker soils in texture but are very shallow over indurated caliche.

The surface layer is underlain at a depth of about 6 inches by a bed of indurated caliche. Loose, rocklike fragments of caliche occur both on the surface and in the soil material.

There are numerous small areas of Potter soils throughout the county, but no large areas.

Profile of Potter loam in the SW¼SW¼ sec. 23, T. 4 S., R. 30 E.

A1—0 to 6 inches, brown (10YR 5/3) loam, brown (10YR 5/3) when moist; very weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; fragments of caliche on the surface and throughout the profile.

C—6 inches+, indurated fractured caliche intermixed with loamy soil material.

The surface layer ranges from 4 to 8 inches in thickness. Its color ranges from 7.5YR to 10YR in hue, from 4 to 5 in value, and from 2 to 4 in chroma. The depth to the C horizon ranges from 4 to 10 inches.

SPRINGER SERIES

The Springer series consists of deep, rapidly permeable, coarse-textured Reddish Brown soils that developed in coarse-textured eolian sediments. These soils have a reddish-brown surface layer that is underlain at a depth of about 14 inches by a weakly developed B2 horizon. The subsoil is fine sandy loam and is about 34 inches thick.

The Springer soils occur in undulating areas and are extensive in the southern and western parts of the county. They are associated with the Tivoli and Brownfield soils. They are darker colored and have stronger horizonation than the Tivoli soils, and they are less red and lack the sandy clay loam subsoil that is characteristic of the Brownfield soils. In many places the Springer soils are in transitional areas between the Amarillo and Tivoli soils.

Profile of Springer loamy fine sand in the NE¼SW¼ sec. 2, T. 1 S., R. 33 E.

A—0 to 6 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; single grain; loose when dry, loose when moist, nonsticky when wet; noncalcareous; clear boundary.

A3—6 to 14 inches, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) when moist; weak, medium, granular structure to single grain; slightly hard to loose when dry, loose when moist, nonsticky when wet; noncalcareous; gradual boundary.

B2—14 to 48 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) when moist; weak, medium, prismatic structure; slightly hard when dry, very friable when moist, slightly sticky when wet; noncalcareous; clear boundary.

C—48 inches, yellowish-red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/8) when moist; single grain; loose when dry, loose when moist, nonsticky when wet; noncalcareous.

The color ranges from 5YR to 7.5YR in hue, from 4 to 5 in value, and from 4 to 8 in chroma. The depth to the C horizon ranges from 36 to 60 inches.

SPUR SERIES

The Spur series consists of deep, brown Alluvial soils that developed in medium-textured or moderately fine textured, strongly calcareous, alluvial sediments deposited on bottoms along the numerous draws and drainageways in the county. These soils occur throughout the county but are most extensive in the western part.

The surface layer, which is about 8 inches thick, is medium-textured and calcareous. The AC horizon is about 12 inches thick, moderately fine textured, and strongly calcareous. It grades to a brown and a light reddish-brown C horizon that is more than 24 inches thick. The C horizon contains nodules and fragments of soft and slightly indurated caliche. In many places these soils contain thin layers of coarse sand and gravel.

Profile of Spur loam, 1,300 feet south of the north quarter corner, and 250 feet east, sec. 13, T. 1 S., R. 30 E.

A1—0 to 8 inches, brown (7.5YR 5/2) loam, dark brown (7.5 YR 3/2) when moist; weak to moderate, medium, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; many roots; many fine and medium pores; strongly calcareous; clear boundary.

AC—8 to 20 inches, dark-brown (7.5YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure; slightly hard or hard when dry, friable when moist, slightly sticky or slightly plastic when wet; few coarse and many medium and fine pores; roots abundant; strongly calcareous; clear boundary.

C1—20 to 31 inches, brown (7.5YR 5/4) light sandy clay loam, dark brown (7.5YR 4/4) when moist; structureless; slightly hard when dry, very friable when moist, slightly sticky, sticky, or slightly plastic when wet; many medium pores and few coarse pores; many roots; mottles (5YR 7/3) common; very strongly calcareous; few fine concretions of calcium carbonate; gradual boundary.

C2—31 to 45 inches, light reddish-brown (5YR 6/4) sandy clay loam, reddish brown (5YR 4/4) when moist; structureless; soft when dry, very friable when moist, slightly sticky or slightly plastic when wet; few coarse and fine pores; few roots; very strongly calcareous; few fine concretions of calcium carbonate.

The surface layer ranges from 4 to 8 inches in thickness and from clay loam to fine sandy loam in texture. The AC and C horizons range from loam to clay loam in texture and in places contain strata of sand and gravel. The color of these horizons ranges from 5YR to 10YR in hue, from 3.5 to 5.5 in value, and from 2 to 4 in chroma.

STEGALL SERIES

The Stegall series consists of moderately deep, moderately fine textured, slowly permeable Chestnut soils. These soils occur in the south-central-part of the county in association with the medium-textured Amarillo soils, which are redder and deeper.

The surface layer is 6 to 8 inches thick, medium textured, and noncalcareous. The B horizon is about 17 inches of reddish-brown clay loam. It has moderate, coarse, prismatic structure that breaks to moderate, medium, subangular blocky structure. A layer of hard caliche occurs at a depth of about 20 to 24 inches.

Profile of Stegall loam, 1/4 mile south and 1/4 mile east of NW corner of sec. 8, T. 5 S., R. 31 E.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; very weak, platy structure that breaks to weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; noncalcareous; abrupt boundary.

A12—2 to 6 inches, reddish-brown (5YR 4/4) heavy loam, dark reddish brown (5YR 3/3) when moist; weak, medium, subangular blocky structure that breaks to weak, fine, granular structure; soft when dry; friable when moist, slightly sticky when wet; many coarse and fine pores; noncalcareous; roots abundant; abrupt boundary.

B1—6 to 8 inches, reddish-brown (5YR 4/4) heavy sandy clay loam, dark reddish brown (5YR 3/3) when moist; moderate to strong, medium, subangular blocky structure; slightly hard when dry, friable when moist, sticky when wet; many fine and coarse pores; numerous roots; noncalcareous; abrupt boundary.

B21t—8 to 13 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) when moist; strong, coarse, prismatic structure that breaks to moderate, medium, subangular blocky structure; very hard when dry, friable when moist, very sticky when wet; thin patchy clay films; many roots; many worm casts; noncalcareous; clear boundary.

B22t—13 to 18 inches, reddish-brown (5YR 5/3) light silty clay loam, reddish brown (5YR 3/3) when moist; strong, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine pores; visible clay films; few roots through peds; noncalcareous; clear boundary.

B3ca—18 to 24 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; strong, medium, prismatic structure; hard when dry, firm when moist, sticky or plastic when wet; many coarse pores and few fine pores; very few roots; strongly calcareous; abrupt, wavy boundary.

IIR—24 inches+, white (5YR 8/1) indurated caliche.

The color ranges from 5YR to 10YR in hue, from 3 to 5 in value, and from 2 to 4 in chroma. The surface layer ranges from 4 to 8 inches in thickness. The A11 and B3ca horizons are lacking in some profiles. The B2 horizon ranges from sandy clay loam to silty clay loam. Depth to the caliche layer ranges from 20 to 36 inches.

TIVOLI SERIES

The Tivoli series consists of deep, loose, sandy Regosols. These soils have little horizonation other than a slightly darkened surface layer. They occur in rolling to dunelike areas and are extensive in the extreme northern and southern parts of the county. They differ from the associated Springer and Brownfield soils in that they have little horizonation and are coarser textured.

Profile of Tivoli very fine sand in the NE1/4 sec. 17, T. 1 S., R. 35 E.

AC—0 to 7 inches, reddish-yellow (7.5YR 6/6) very fine sand, strong brown (7.5YR 5/6) when moist; slightly darker colored in uppermost 4 inches; single grain; noncalcareous; abrupt boundary.

C—7 to 61 inches, reddish-yellow (7.5YR 7/8) fine sand, reddish yellow (7.5YR 6/8) when moist; loose; single grain; noncalcareous; abrupt boundary.

The surface layer ranges from 2 to 8 inches in thickness and in most places can be recognized only by a thin organic staining on the sand grains. In places buried profiles occur at a depth ranging from 8 to 12 feet or more. These profiles are similar to the red sandy clay subsoil and parent material of the Brownfield soils.

TRAVESSILLA SERIES

The Travessilla series consists of very shallow Lithosols that developed in material weathered from Dakota sandstone, siltstone, and shale. These soils occur on rough terrain in the panhandle area of the county. They generally are less than 10 inches thick and overlie sandstone bedrock that is interbedded with shale. The pale-brown to light yellowish-brown A horizons are moderately coarse-textured or medium-textured, granular, and calcareous.

Profile of Travessilla loam in the NW1/4NE1/4SW1/4 sec. 6, T. 3 N., R. 30 E.

A11—0 to 3 inches, pale-brown (10YR 6/3) gravelly loam, brown (10YR 5/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky or sticky when wet; numerous medium and coarse pebbles; strongly calcareous; clear boundary.

A12—3 to 8 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; moderate to strong, coarse, granular structure; soft to slightly hard when dry, friable when moist, sticky when wet; numerous medium and coarse pebbles coated with calcium carbonate; intermixed sandstone, igneous material, and shale; strongly calcareous; abrupt boundary.

R—8 to 13 inches +, light yellowish-brown weathered calcareous sandstone; becomes harder with depth.

The surface layer ranges from 2 to 10 inches in thickness. In places the A11 horizon is lacking.

ZITA SERIES

The Zita series consists of medium-textured to moderately coarse textured Chestnut soils that developed in level or nearly level areas. These soils are associated with the Portales, Clovis, and Olton soils. They differ from the Portales soils in that they are noncalcareous in the upper

part of the profile and have stronger horizonation. They are similiar to the Clovis soils in structure and in texture but are less red. They are less well developed than the Olton soils.

Profile of Zita fine sandy loam, 120 feet west and 390 feet south of the pasture gate in sec. 6, T. 3 S., R. 32 E.

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) fine sandy loam, dark brown (10YR 3/3) when moist; uppermost 1 inch has weak, platy structure, lower 4 inches has weak, medium or fine, granular structure; friable when moist, nonsticky when wet; abundant roots; noncalcareous; clear, smooth boundary.

AC—5 to 11 inches, dark grayish-brown (10YR 4/2) sandy clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure; hard when dry, friable when moist, slightly sticky or slightly plastic when wet; many worm casts and open pores; noncalcareous; clear, wavy boundary.

C1—11 to 20 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure; hard when dry, friable when moist, slightly sticky or slightly plastic when wet; porous; many worm casts; noncalcareous or slightly calcareous, lime mottles; abrupt boundary.

C2ca—20 to 30 inches, white (10YR 8/1) sandy clay loam, light brownish gray (10YR 6/2) when moist; massive; strongly calcareous; gradual to clear boundary.

The A1 horizon ranges from 4 to 8 inches in thickness and from 7.5YR to 10YR in hue, from 3 to 5 in value, and from 2 to 4 in chroma. Zita soils that are closely associated with the Mansker and Portales soils have a slightly calcareous surface layer.

Mechanical and Chemical Analyses

Data obtained by mechanical and chemical analyses for six selected soils in Roosevelt County are given in table 8. These data are useful to soil scientists in classifying soils and in developing concepts of soil genesis. They are also helpful for estimating water-holding capacity, hazard of wind erosion, fertility, tilth, and other practical aspects of soil management. Profiles of the soils listed in table 8 are described in detail in the section "Formation and Classification of Soils."

Field and Laboratory Methods

All samples used to obtain the data in table 8 were collected from carefully selected sites. The samples are considered representative of the soil material that is made up of particles less than three-quarters of an inch in diameter. Estimates of the fraction of the sample consisting of particles larger than three-quarters of an inch were made during the sampling. If necessary, the sample was sieved after it was dried and rock fragments larger than three-quarters of an inch in diameter were discarded. Then the material made up of particles less than three-quarters of an inch was rolled, crushed, and sieved to remove rock fragments larger than 2 millimeters in diameter. Only trace amounts of material larger than 2 millimeters in diameter were removed from the samples and discarded.

Laboratory analysis was made on material that passed the 2-millimeter sieve and that was oven dry. In table 8, values for extractable cations are for amounts extracted by normal ammonium acetate.

Standard methods of the Soil Survey laboratories were used to obtain most of the data in table 8. Determinations of clay were made by the pipette method (*4*, *5*, *7*). The reaction of the saturated paste and that of a 1:10 water suspension were measured with a glass electrode. Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (*8*). The calcium carbonate equivalent was determined by measuring the quantity of hydrochloric acid required to neutralize the carbonate minerals. The cation exchange capacity was determined by direct distillation of absorbed ammonia (*8*). To determine the extractable calcium and magnesium, calcium was separated as calcium oxalate and magnesium as magnesium ammonium phosphate (*8*). Extractable sodium and potassium were determined on original extracts with a flame spectrophotometer. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract (*11*).

Additional Facts About the County

In the early 1860's the eastern part of New Mexico was exclusively grazing country. During this period, cowboys from Texas territory drifted their cattle east and northeast in search of grass and new waterholes. The railroad, which was completed in 1901, speeded the development of the area.

Roosevelt County was formed in 1903 from parts of Lincoln, Lea, De Baca, Eddy, and Chaves Counties. Portales became the county seat. The population at first consisted mainly of men employed to construct the railroads, but homesteaders soon began to populate the town and countryside. At first life was hazardous. Drought, cold, disease, and economic depression caused many to give up their farms and sell their livestock.

Irrigation in Roosevelt County began in 1909, when the Portales Irrigation Company was incorporated. A year later, 69 pumps had been installed to lift water from the known underground storage basin. The Portales Valley was declared an underground water basin on May 1, 1950. This declaration fixed the boundaries of the basin and recognized the vested right of all wells within the area. The drilling of new wells or the irrigation of new areas from existing wells now requires a permit.[6]

Today, Roosevelt County is a diversified farming area. In addition to beef production, there are many dairy, hog, and chicken enterprises. Broomcorn, grain sorghum, wheat, and corn are grown on dryland farms. Peanuts, cotton, sweetpotatoes, onions, and small vegetables are the main cash crops in irrigated areas. Other crops are alfalfa for hay, irrigated grasses for pasture, and sorghum for silage and grain. A small acreage is used for castor beans.

Portales, the county seat, is serviced by the Santa Fe railroad, U.S. Highway No. 70, and several State highways and farm-to-market blacktop roads. Eastern New Mexico University, a high school, and four grade schools are located in Portales. There are also four rural high schools and grade schools throughout the county. Industry consists of three peanut processing plants, several cotton gins, a dairy processing plant, a sweetpotato packing

[6] A copy of the MANUAL OF RULES AND REGULATIONS FOR USE OF UNDERGROUND WATERS IN DECLARED BASINS OF NEW MEXICO can be obtained by writing to the State engineer, Santa Fe, N. Mex.

plant, a meat packing plant, several grain elevators, a commercial printing plant, and a daily newspaper.

Physiography, Relief, and Drainage

Roosevelt County, on the western edge of the southern High Plains, is a broad, gently tilted plain. From an elevation of 4,600 feet, in the extreme northern part of the panhandle, this plain tilts generally in a south-southeast direction to the vicinity of Floyd, where the elevation is 4,400 feet. With the exception of the Kenna Mesa area, where the elevation again climbs to 4,600 feet, the gradual decline in elevation continues in a southeasterly direction through Dora, Pep, and Milnesand, which are at an elevation of approximately 4,200 feet. From the northeastern corner of the county, the 4,000-foot contour extends through Portales and then in a southeasterly direction through Causey, Lingo, and Bluit. From Bluit, this contour continues slightly southwest into Lea County.

On this gently tilted plain are numerous depressions called playas. Two of the largest are Lewiston Lake, northwest of Elida, and Salt Lake, near Arch. The latter is at an elevation of about 3,900 feet and is the lowest area in the county.

Drainage in the county is mostly internal, although numerous small draws and drainageways carry floodwater from higher areas. Boone Draw, the largest of these drainageways, extends from the Kenna Mesa through Elida in the direction of the Portales Valley. Alamosa Creek, the only true creek in the county, is located in the northern part of the panhandle. This creek flows southwestward to the Pecos River.

The sandhills in the extreme northern and southern parts of the county help to break the generally smooth, nearly level plain. Besides serving as natural catchment areas through which rainfall is fed to the underground basin, the sandhills are excellent refuge areas for game birds, antelope, and other wildlife.

Geology

The Great Plains Province extends from the Canadian border south into Mexico. The southern High Plains, which includes Roosevelt County, is a part of this province. Following is a brief review of the geology of this part of the High Plains.

Prepleistocene geology.—About 200 million years ago, a shallow (permian) sea covered the southern High Plains. The materials laid down in this sea consisted primarily of fine sand, silt, and clay. Today, these sediments are known as the Permian Red Beds.

During the rise of the Appalachian Mountains, some 185 million years ago, the sea retreated, exposing rocks and sedimentary sea deposits. The subsequent weathering action on this surface created the material recognized today as the Triassic Red Beds, distinguished from the Permian sediments by being markedly more red in color. These deposits represent the floor of most of the water wells being drilled throughout the county.

Just prior to the formation of the Rocky Mountains, some 60 million years ago, the area was again submerged by a shallow sea. This sea deposited the blue shale, blue and yellow clay, limestone, sandstone, sand, and gravel identified today as Cretaceous sediments. Only scattered areas of these Cretaceous deposits are found in Roosevelt County, probably because of the vigorous erosional activity that accompanied the Rocky Mountain revolution (*3*).

The Ogallala formation, the water-bearing strata presently being tapped for domestic and irrigation use, resulted from the rise of the Rocky Mountain chain. As the mountains were worn down by erosion, the streams began to deposit sand, gravel, and silt near their source. These deposits formed alluvial fans of coarse gravelly material along foot slopes of the mountains; the finer materials were moved and spread farther to the east. The Ogallala formation developed in these deposits of outwash material. Fresh water saturated the material at times during its deposition.

Pleistocene geology.—This period in geologic history is commonly called the Ice Age. Within this period, estimated to encompass about a million years on the geologic time table, four and perhaps five different advances and retreats of ice occurred over the northern third or half of the United States. Although the ice did not advance as far south as the southern High Plains, the effect of the wet and dry cycles of the glacial and interglacial periods had a profound effect on the climate, vegetation, and soil formation of the area.

Following the initial wet cycle, the intermittent dry cycles caused increased deposition of eolian sands upon the region. During the alternate wet periods, these deposits were saturated with water high in minerals, principally calcium. Following each saturation and during the next dry cycle, caliche (calcium carbonate) was precipitated as a cap over the windblown material.

It is believed that the protective vegetation was destroyed during each dry period and that wind activity increased. In places where the caliche was less mature, the winds scooped out depressions that are now the characteristic playas. The deposition and solution of minerals, followed by drought and chemical precipitation of minerals, took place at least three and perhaps five times during the Pleistocene age. With each cycle the lakes were enlarged and new materials were deposited. To soil scientists, the buried soil profiles with their characteristic enriched lime zones, clay horizons, and some evidence of obscure A horizons are evidence of these wet and dry geologic periods.

The number of exposed igneous gravel terraces throughout the county are evidence that during the early Pliocene or late Pleistocene age eroding streams were active over much of the area. The gravel pit north of Portales is an example of these relic terraces.

Recent geology.—In this period, perhaps the last 10 thousand years in geologic time, the climate of the southern High Plains has been relatively dry and stable.

Since the ice age, tributaries of the Pecos River, eroding headward to the north, and tributaries of the Canadian River, eroding headward to the west, have met and have eroded through the Ogalalla formation into the underlying red beds. At present the Ogalalla formation is at a higher elevation on the High Plains than the surface of all sides. No water enters it from the Rocky Mountains. The only recharge of any consequence for the ground water reservoir is from rain or snow that falls on the High Plains. (See footnote 5, p. 59.)

In addition to the Canadian and Pecos Rivers, the an-

TABLE 8.—*Analytical*

[Analyses made at Cooperative Soils Laboratory, Soil Conservation Service, and New Mexico

Soil type, location of sample, and sample number	Horizon	Depth	Particle size distribution: Very coarse sand (2.1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)
		In.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Amarillo loamy fine sand:									
Location: 0.05 mile west	A11	0–2	0.1	0.9	4.0	52.2	25.4	10.6	6.8
of the SE corner of sec.	A12	2–6	.1	1.2	5.5	58.4	22.2	7.0	5.6
27, T. 1 S., R. 31 E.	A13	6–10	.2	1.2	6.3	59.8	20.4	5.1	7.0
(*Laboratory No.*	B1	10–17	.1	1.0	4.8	51.6	21.2	5.1	16.2
639–647.)	B21t	17–29	.2	1.0	3.8	40.0	22.5	15.1	17.4
	B22t	29–44	.2	1.3	4.5	39.4	22.6	11.2	20.8
	B3ca	44–51	.4	1.9	4.8	41.0	20.6	9.7	21.6
	C1ca	51–72							
	C2ca	72–82	4.0	3.4	3.4	24.0	22.2	25.0	18.0
Blackwater loam:									
Location: SW¼SE¼ sec.	A1p	0–5	.3	1.0	3.4	19.6	26.3	24.9	24.5
20, T. 1 S., R. 34 E.	A2	5–9	.1	.7	2.2	14.8	14.7	27.0	40.5
(*Laboratory No.* 6818–	B2t	9–17	.1	.8	2.4	16.3	14.3	21.6	44.5
6821.)	B3cag	17–22	0	.8	2.9	18.4	14.2	21.6	42.1
	IIR	22+							
Brownfield fine sand:									
Location: ¼ mile east and	A11	0–2	0	.9	13.6	56.1	17.9	8.3	3.2
1,000 feet north SW.	A12	2–15	0	1.1	15.9	61.4	15.8	3.0	2.8
corner sec. 32, T. 2 S.,	A3	15–23	.1	1.3	14.2	48.2	14.7	17.2	4.3
R. 33 E. (*Laboratory*	B21t	23–33	0	1.1	11.2	48.1	16.5	8.1	15.0
No. 727–734.)	B22t	33–50	.1	1.2	11.2	42.5	16.8	4.5	23.7
	B3	50–64	.1	1.7	12.0	42.5	15.9	15.8	12.0
	C1	64–97	.1	1.4	11.1	44.5	14.1	4.8	19.0
	C2ca	97–113	.5	2.1	13.5	44.6	14.7	5.1	19.5
Clovis loam:									
Location: NW¼SW¼ sec.	A11	0–2	.1	1.2	2.7	24.2	43.1	14.0	14.7
19, T. 2 S., R. 30 E.	A12	2–5	.2	1.1	3.0	24.2	41.7	16.8	13.0
(*Laboratory No.* 617–	B1	5–14	.2	1.4	3.2	24.4	36.6	18.5	15.7
623.)	B2t	14–18	.3	1.5	3.6	23.3	29.8	16.4	25.1
	B3ca1	18–26	.2	1.4	3.5	20.8	26.1	24.4	23.6
	B3ca2	26–32	.1	1.2	3.4	21.2	28.2	17.5	28.4
	Cca	32–50	.5	1.9	3.9	22.6	24.8	18.4	27.9
Portales loam:									
Location: SW¼NE¼SE¼	A1p	0–8	.2	1.2	3.4	29.0	25.6	20.0	20.6
sec. 24, T. 1 S., R. 33	AC	8–22	.5	1.4	3.2	28.9	23.1	19.3	23.6
E. (*Laboratory No.* 69–	C1ca	22–27	.2	1.1	2.6	27.8	22.3	20.3	25.7
76.)	C2ca	27–60	1.4	3.2	2.8	50.8	29.6	12.0	.2
Zita fine sandy loam:									
Location: 120 feet west	A1	0–5	.1	1.1	9.7	40.8	20.8	16.7	10.8
and 390 feet south of	AC	5–11	.1	1.0	9.7	42.9	16.8	9.1	20.4
pasture gate, sec. 6, T.	C	11–20	.1	.7	6.8	39.2	17.4	14.4	21.4
3 S., R. 32 E. (*Labora-*	Cca	20–30	.9	3.6	6.7	24.8	11.9	20.7	31.4
tory No. 735–739.)									

[1] Trace.

cient Brazos River influenced the geology of the Portales Valley. The headward cutting of the Pecos River bisected the Brazos River 2 miles south of Fort Sumner in De Baca County, N. Mex. From the time the tributaries of the Canadian and Pecos Rivers merged, the flow of water into the Brazos dwindled, became intermittent, and finally ceased. The remnant of this dry channel is now known as the Portales Valley. This area is underlain at various depths by the characteristic white to light-gray, soft caliche. (See footnote 5, p. 59.)

The sandhills of Roosevelt County have their origin in Recent geologic time. They are wind-deposited sands that parallel the north and northwest sides of relict drainage channels, such as the Double Mountain Fork of the Brazos River. In places the drainage system that contributed to the source of the sand is obscured by the sand deposits themselves, but soil borings in the area reveal characteristic alluvial chalky sediments.

data for selected soils

Agricultural Experiment Station. Lack of data indicates value was not determined]

Chemical properties									
Cation exchange capacity (NH_4AC)	Extractable cations			Electrical conductivity ($Ec \times 10^3$)	Estimated salt	Reaction (saturated paste)	$CaCO_3$ equivalent	Organic carbon	Nitrogen
	Mg	Na	K						
Meq./100 gm.	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Millimhos per cm. at 25° C.*	*Pct.*	*pH*	*Pct.*	*Pct.*	*Pct.*
6.6	1.0	0	0.5	1.0	0.05	6.9	0.41	0.60	0.062
5.3	.6	0	.2	.7	<.02	6.6	.26	.45	.039
6.1	.7	0	.2	.8	.04	6.6	.31	.40	.042
10.4	1.3	0	.4	.9	.06	6.5	.32	.60	.044
12.9	1.4	0	.4	1.0	.10	6.7	.10	.43	.049
12.4	1.3	0	.4	.8	.10	7.0	(1)	.22	.034
11.2	1.3	.2	.4	.8	.08	7.7	6.57	.09	.026
---	---	---	---	---	---	---	---	---	---
9.3	---	.2	.2	.6	.05	8.0	27.47	35	.019
9.6	---	1.0	10.4	2.0	.11	7.8	.5	.75	---
23.3	---	1.7	7.6	1.1	.13	7.8	.4	.87	---
24.0	---	1.9	7.9	1.3	.14	7.7	.5	.63	---
21.0	---	1.8	8.6	2.5	.15	7.7	4.3	.52	---
---	---	---	---	---	---	---	---	---	---
3.7	.8	.2	.3	---	---	7.4	.05	.53	.010
3.5	.8	.2	.2	---	---	7.2	.12	.21	.010
4.0	.7	.2	.3	---	---	7.1	.09	.18	.010
11.9	.9	.3	.4	---	---	6.7	.06	.23	.010
15.1	1.3	.3	.5	---	---	6.7	0	.24	.010
11.3	1.7	.3	.2	---	---	7.0	.18	.22	.017
12.5	2.3	.3	.3	---	---	6.8	.02	.10	.007
13.8	2.0	.5	.3	---	---	7.8	5.18	.03	.024
8.5	1.3	.2	.7	.5	.02	7.1	.26	.67	.058
10.5	1.2	.2	1.0	1.0	.07	7.3	.33	.63	.061
12.8	1.7	.3	1.2	1.0	.12	7.3	.47	.64	.080
14.9	2.7	.3	.7	.7	.11	7.5	.55	.56	.056
19.1	15.7	.3	.7	.8	.12	7.6	4.71	.48	.047
17.1	11.0	.4	.7	.9	.12	7.7	9.47	.26	.026
14.9	10.6	.4	.6	.8	.11	7.8	17.17	.19	.028
12.3	1.7	.32	1.1	.94	.08	8.1	.6.9	.83	.070
9.4	1.2	.25	.9	.57	.05	8.1	12.0	.68	.067
9.4	1.1	.27	.8	.60	.05	8.1	14.8	.57	.059
---	---	---	---	---	.02	8.2	24.8	---	---
·10.8	2.1	.5	.6	.8	.09	7.2	.30	1.21	.097
14.8	2.4	.6	.7	1.0	.11	7.0	.31	.88	.097
17.1	.6	.6	.6	1.0	.11	7.4	3.26	.93	.108
13.5	1.5	.5	.4	.6	.08	8.4	39.47	.55	.052

Climate [7]

Roosevelt County has a semiarid, continental climate. Winds bring moisture into the area from the Gulf of Mexico. Because of the more favorable summer wind circulation, 73 percent of the average annual rainfall normally occurs during the months of May through September. Much of this precipitation falls in the form of brief and, at times, heavy thundershowers. Occasionally, an upslope circulation of air bringing moisture from the Gulf will cause light or moderate rainfall for a period of several hours. During winter months, part of the moisture falls in the form of snow, but the average annual snowfall is less than 10 inches, and snowstorms seldom account for any appreciable amount of moisture.

Records of several stations indicate that the average annual precipitation in the county varies from 17 inches in the northeastern part, where the elevation is slightly

[7] Prepared by G. F. VON ESCHEN, State climatologist, U.S. Weather Bureau.

less than 4,000 feet above sea level, to 14 inches along the western border, where the elevation is about 4,600 feet.

Table 9 shows temperature and precipitation data based on a 30-year record at the U.S. Weather Bureau Station at Portales, N. Mex. Precipitation totals may vary widely, however, in the same month from year to year, and frequently a major part of a month's precipitation falls in one brief shower. Consequently, monthly precipitation totals, and more particularly annual precipitation totals, are not too reliable an indication of the agricultural effectiveness of the moisture received. For example, the annual precipitation recorded at Portales for 1950 was 20.67 inches, or almost 25 percent above normal. Nevertheless, during that year there were only 15 days with as much as 0.25 inch of precipitation, and those 15 days occurred during a 6 month period, with no such days recorded in the other 6 months of the year.

During the summer season, April through September, the interval between rainfalls of 0.25 inch or more averages 7 days. During this season there is one chance in four that the interval between such rains will be 4 days; an even chance that the interval will be 5 to 21 days; and one chance in four that the interval will exceed 21 days. In the period from October through March, the interval between rains of 0.25 inch or more is considerably longer, averaging 22 days. During this winter period, there is one chance in four that the interval between such rains will be 10 days; an even chance that the interval will be from 10 to 45 days; and one chance in four that the interval will exceed 45 days. Occasionally, the interval between rains of 0.25 inch or more will exceed 2 months during the summer period and will exceed 4 months during the winter period. The longest such period noted in reviewing the 30-year record at Portales was 204 days. It extended from October 8 to April 29.

As the annual rainfall for the county is only about 15 inches, moisture frequently is marginal for the growth of dryland crops. Seasonal distribution favors the development of summer vegetation, since about three-fourths of the annual moisture is received during the period from May through September.

The temperature of Roosevelt County is characteristic of continental climate. There is a distinct seasonal change and normally a relatively wide range in annual and daily temperatures. The variation in daily temperature, or the difference between the high and low readings, commonly is more than 30 degrees. Consequently, during hot periods in summer, nights generally are comfortably cool, and during cold periods in winter, days warm up appreciably. In winter, the masses of cold air that form in Canada occasionally push far enough southward and westward to affect the temperature of the county, but such invasions of cold air are rare and generally are of short duration. Normally, only 1 year in 10 will any month have as many as 4 days with temperatures falling below zero. There will be an average of only 2 days a year when the temperature will drop below zero. There will be an average of only 4 days a year when the temperature fails to rise above the freezing mark at some time during the day. During the summer months, daytime temperatures will be 90° F. or higher on approximately 75 days. There will be only 6 days on an average when the temperature will rise to 100° F. or higher. All stations throughout

TABLE 9.—*Temperature and precipitation data*

[Based on data from a 30-year record, from 1931 through 1960, at Portales, Roosevelt County, N. Mex.]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 5 will have—		Average number of days with precipitation of—	
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—	0.10 inch or more	0.25 inch or more
					Inches	*Inches*	*Inches*		
January	53	21	68	8	0.46	0.01	0.79	1	1
February	58	25	72	11	.36	.08	.75	1	(1)
March	65	31	79	18	.54	.06	1.14	1	1
April	75	40	88	27	.77	.11	1.49	2	1
May	82	50	94	39	2.42	.66	3.38	4	3
June	91	59	100	50	2.38	.50	4.00	4	3
July	93	63	101	57	2.91	1.04	3.84	4	3
August	92	62	100	55	2.66	.71	3.52	4	2
September	85	54	96	42	1.91	.34	3.41	3	2
October	75	43	87	31	1.50	.47	1.78	3	2
November	63	29	77	17	.45	(2)	.80	1	1
December	55	23	71	12	.58	.04	.98	2	1
Year	74	42	[3] 103	[4] −2	16.94	10.83	18.65	30	20

[1] Less than 0.5 day.
[2] Trace.
[3] Average annual highest maximum.
[4] Average annual lowest minimum.

TABLE 10.—*Probabilities of occurrence of specified temperatures in spring and in fall*

[Based on data from records for period 1929–60, at Portales, Roosevelt County, N. Mex.]

Probability	Dates for given probability at temperature levels shown				
	24° F.	28° F.	32° F.	36° F.	40° F.
Spring:					
1 year in 10, later than	April 15	April 22	May 5	May 13	June 2.
2 years in 10, later than	April 10	April 18	May 2	May 12	May 25.
5 years in 10, later than	March 31	April 10	April 19	May 3	May 13.
Fall:					
1 year in 10, earlier than	October 25	October 23	October 4	September 23	September 16.
2 years in 10, earlier than	November 2	October 24	October 7	September 28	September 24.
5 years in 10, earlier than	November 7	November 1	October 21	October 12	October 4.

the county show an annual mean temperature of 58 degrees.

The average annual humidity in the county is near 52 percent. During the warmest part of the day, the humidity will range from near 30 percent in June to near 40 percent in January. Periods of low winter temperatures or of high summer temperatures generally are associated with clear, sunny weather and low humidity.

Hail will occasionally cause serious crop loss over limited areas. For the county it seems that appreciable crop damage does not occur more frequently than about once each year.

Wind records are not available for Roosevelt County, but records at nearby stations indicate an average wind velocity of about 12 miles per hour. March normally is the windiest month of the year, with an average velocity exceeding 15 miles per hour. Late in fall velocities drop to less than 10 miles per hour. Late in winter and in spring, wind velocities of more than 24 miles per hour can be expected about 5 percent of the time. Since this frequently is the driest period of the year, there is always a possibility that such winds will cause serious soil erosion, particularly on light soils that have little or no vegetation. This is particularly true if such winds occur following an extended period of little or no precipitation.

Only five tornadoes have been reported from 1916 to date, none of which have caused serious damage or loss of life.

Records showing water loss by evaporation from a class A evaporation pan have been kept near Portales for the period from 1934 to 1960. These records show that approximately 92 inches of water are evaporated each year, or about six times the normal annual rainfall. Water loss by evaporation is greatest in June. In that month water loss amounts to about 12.5 inches. During midwinter, the water loss by evaporation is about 3 inches per month.

Table 10 shows the probability of the occurrence of the last freezing temperature in spring and the first freezing temperature in fall and other temperature thresholds. These data are based on temperature readings made in an instrument shelter approximately 5 feet above the ground. Thus, at times temperatures at the ground level may be several degrees lower than those recorded in the shelter.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Blowout. An excavation produced by wind action in loose soil, usually sand.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Eolian. Soil parent material accumulated through wind action; commonly refers to sandy material in dunes.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, mineralogical, and biological properties of the various horizons of the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct, and prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Playa. A shallow, flat-bottomed, undrained basin that contains water for short periods following rains.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Runoff. The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments in soils have diameters ranging from 0.05 to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil material that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil material that is 80 percent or more silt and less than 12 percent clay.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or D horizon.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Water-holding capacity. The ability of a soil to hold water that will not drain away but can be taken up by plant roots.

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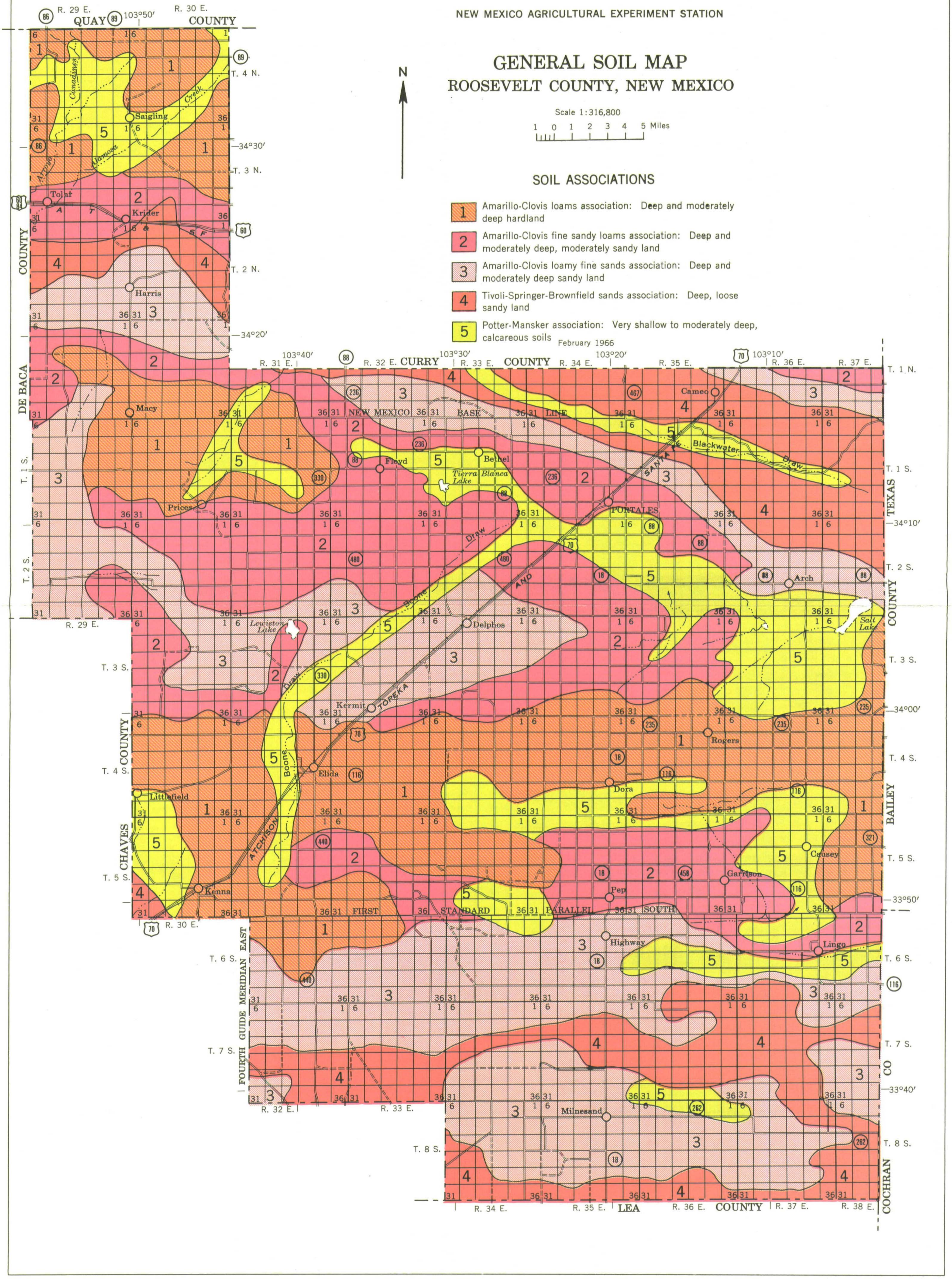
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
ROOSEVELT COUNTY, NEW MEXICO

Scale 1:316,800



SOIL ASSOCIATIONS

1 Amarillo-Clovis loams association: Deep and moderately deep hardland

2 Amarillo-Clovis fine sandy loams association: Deep and moderately deep, moderately sandy land

3 Amarillo-Clovis loamy fine sands association: Deep and moderately deep sandy land

4 Tivoli-Springer-Brownfield sands association: Deep, loose sandy land

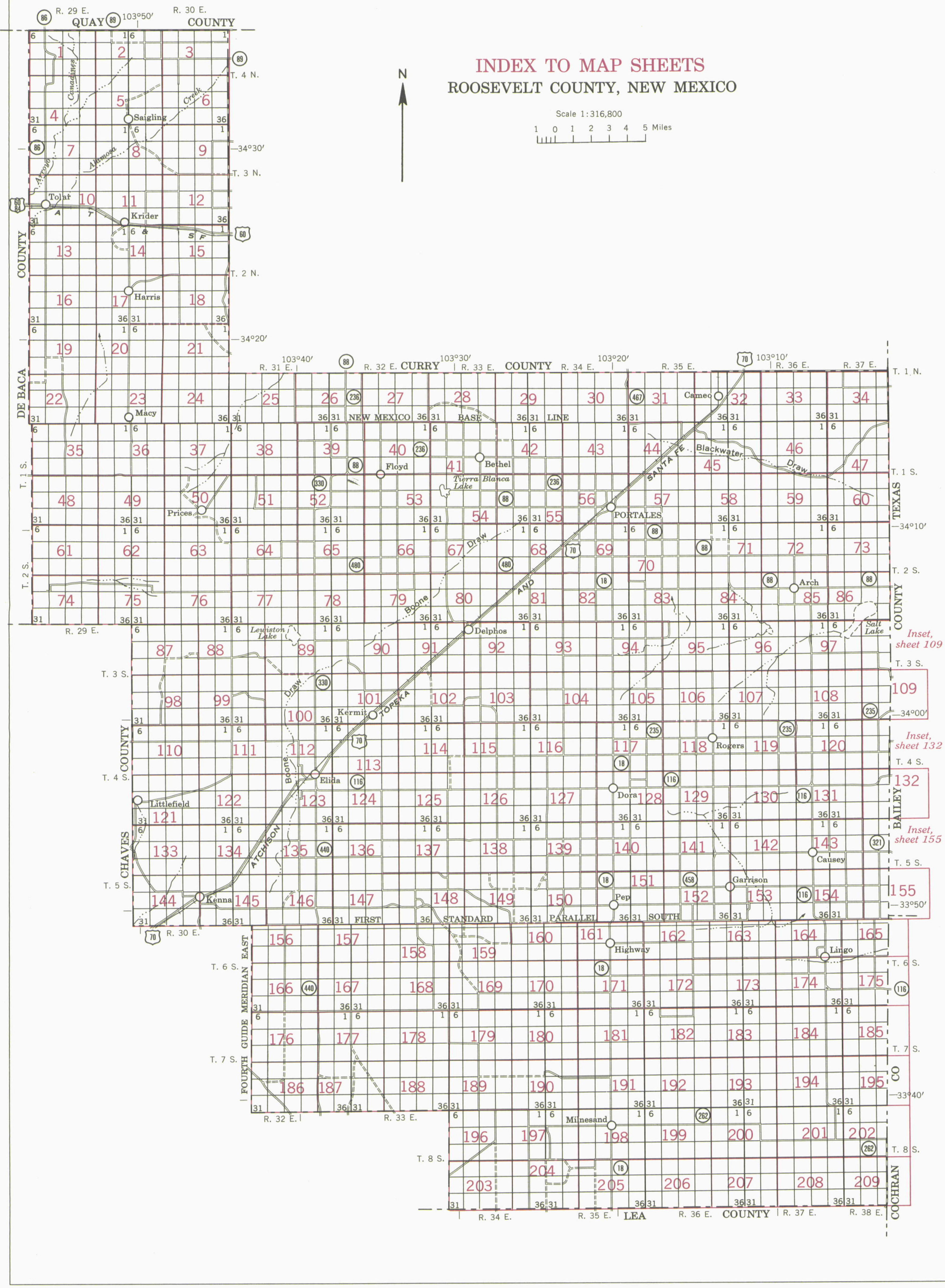
5 Potter-Mansker association: Very shallow to moderately deep, calcareous soils

February 1966

INDEX TO MAP SHEETS

ROOSEVELT COUNTY, NEW MEXICO

Scale 1:316,800



SOIL LEGEND

SYMBOL	NAME
Aa	Amarillo loamy fine sand, 0 to 3 percent slopes
Ab	Amarillo fine sandy loam, 0 to 1 percent slopes
Ac	Amarillo fine sandy loam, 1 to 3 percent slopes
Ad	Amarillo loam, 0 to 1 percent slopes
Ae	Amarillo loam, 1 to 3 percent slopes
Af	Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded
Ag	Arch loamy fine sand
Ah	Arch fine sandy loam
Ak	Arch loam
Am	Arch soils, severely eroded
An	Arvana loamy fine sand, 0 to 3 percent slopes
Ao	Arvana loamy fine sand, shallow, 0 to 1 percent slopes
Ap	Arvana fine sandy loam, 0 to 1 percent slopes
Ar	Arvana fine sandy loam, 1 to 3 percent slopes
As	Arvana fine sandy loam, shallow, 0 to 1 percent slopes
Av	Arvana soils, 0 to 3 percent slopes, severely eroded
Ba	Berthoud sandy loam, 2 to 9 percent slopes
Bb	Bippus and Spur soils
Bc	Blackwater loam
Bd	Blown-out and dune land
Be	Brownfield fine sand
Bf	Brownfield soils, severely eroded
Ca	Church clay loam
Cb	Church soils, severely eroded
Cc	Clovis loamy fine sand, 0 to 3 percent slopes
Cd	Clovis fine sandy loam, 0 to 1 percent slopes
Ce	Clovis fine sandy loam, 1 to 3 percent slopes
Cf	Clovis loam, 0 to 1 percent slopes
Cg	Clovis loam, 1 to 3 percent slopes
Dr	Drake soils
Go	Gomez loamy fine sand
Hg	Hilly gravelly land
Ka	Kimbrough fine sandy loam
Kb	Kimbrough loam
Mc	Mansker and Portales fine sandy loams, 1 to 3 percent slopes
Md	Mansker and Portales loams, 1 to 3 percent slopes
Me	Montoya clay loam
Ot	Olton loam, 0 to 1 percent slopes
Oz	Olton-Zita loams, 0 to 1 percent slopes
Pa	Portales fine sandy loam, 0 to 1 percent slopes
Pb	Portales loam, 0 to 1 percent slopes
Pc	Potter soils, 0 to 9 percent slopes
Ra	Riverwash
Rb	Rough broken land
Sf	Springer loamy fine sand
Sp	Springer soils, severely eroded
St	Stegall loam, 0 to 1 percent slopes
Su	Stegall loam, 1 to 3 percent slopes
Sw	Stegall loam, shallow, 0 to 1 percent slopes
Tf	Tivoli fine sand
Th	Tivoli-Arch complex
Tr	Travessilla loam
Zf	Zita fine sandy loam, 0 to 1 percent slopes
Zm	Zita loam, 0 to 1 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, caliche, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Windmill with stock tank, cistern, or small reservoir

Oil or gas wells

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL / DITCH

Lakes and ponds
- Perennial
- Intermittent

Well, irrigation

Water storage reservoir, irrigation

Marsh

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large / Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies
- Overblown soil along fence or field boundary

Soil map constructed 1965 by Cartographic Division, Soil Conservation Service, USDA, from 1959 aerial photographs. Controlled mosaic based on New Mexico plane coordinate system, east zone, transverse Mercator projection, 1927 North American datum.

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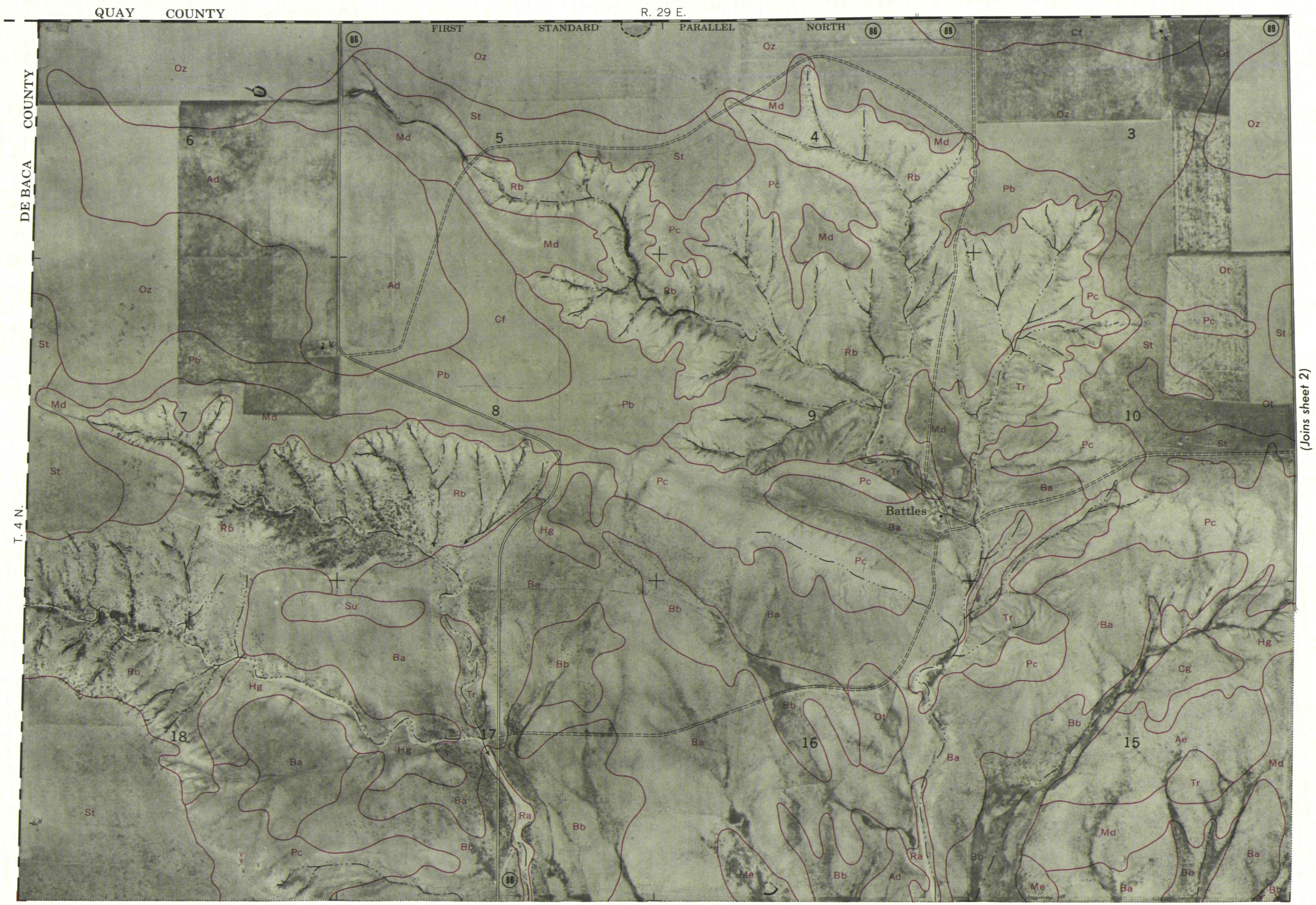

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

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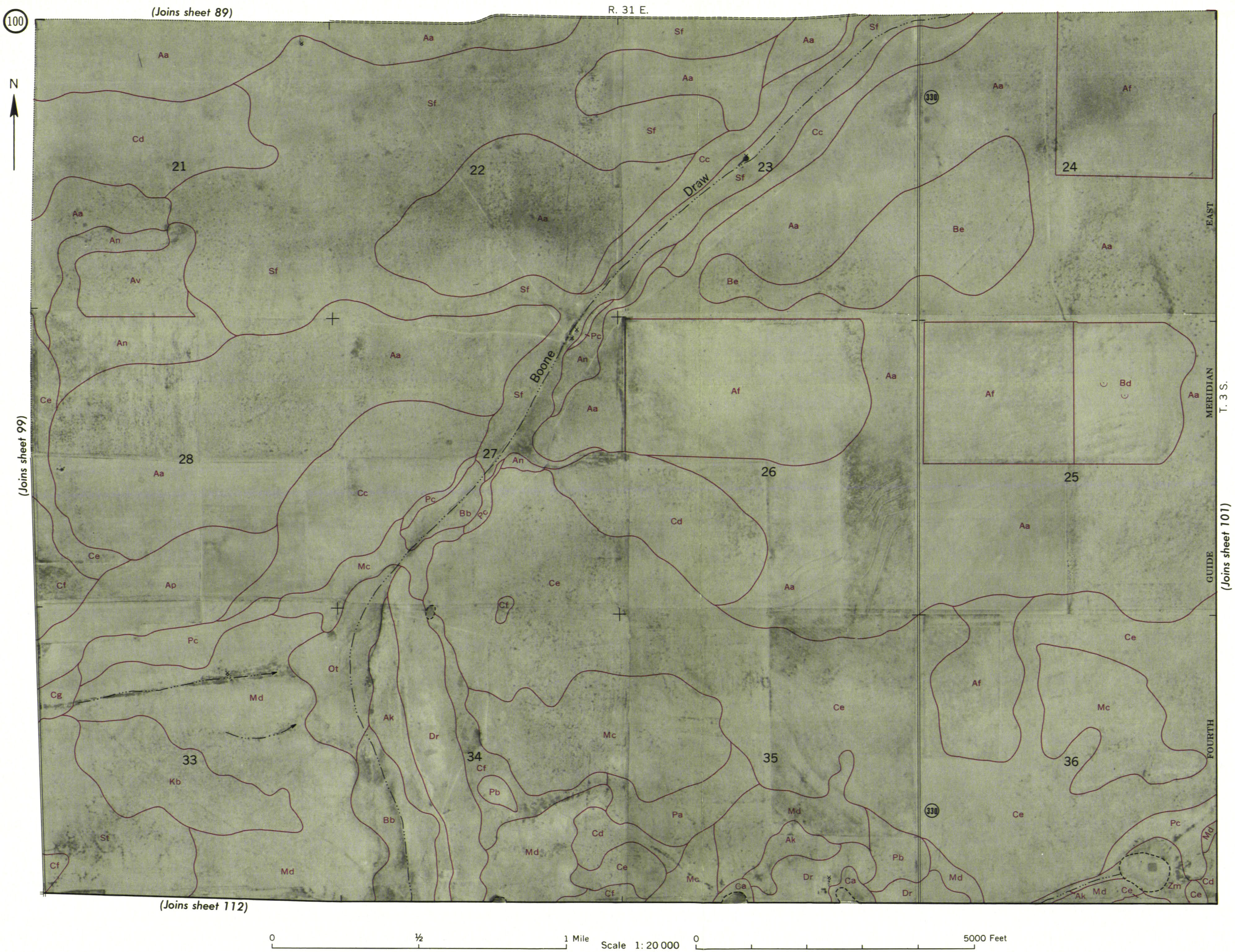
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T. 3 S.
FOURTH GUIDE MERIDIAN EAST
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1 Mile
Scale 1: 20 000
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5000 Feet

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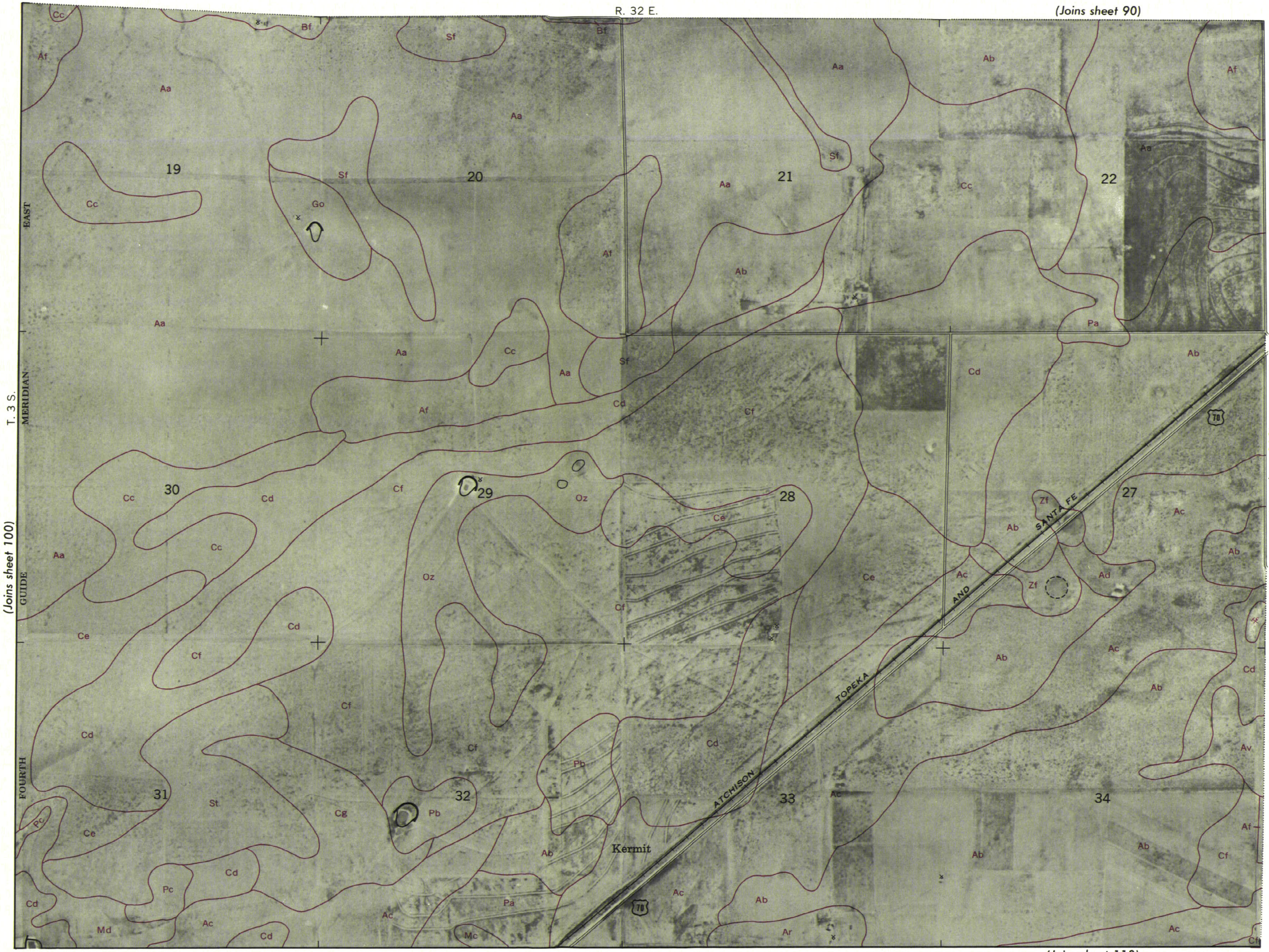

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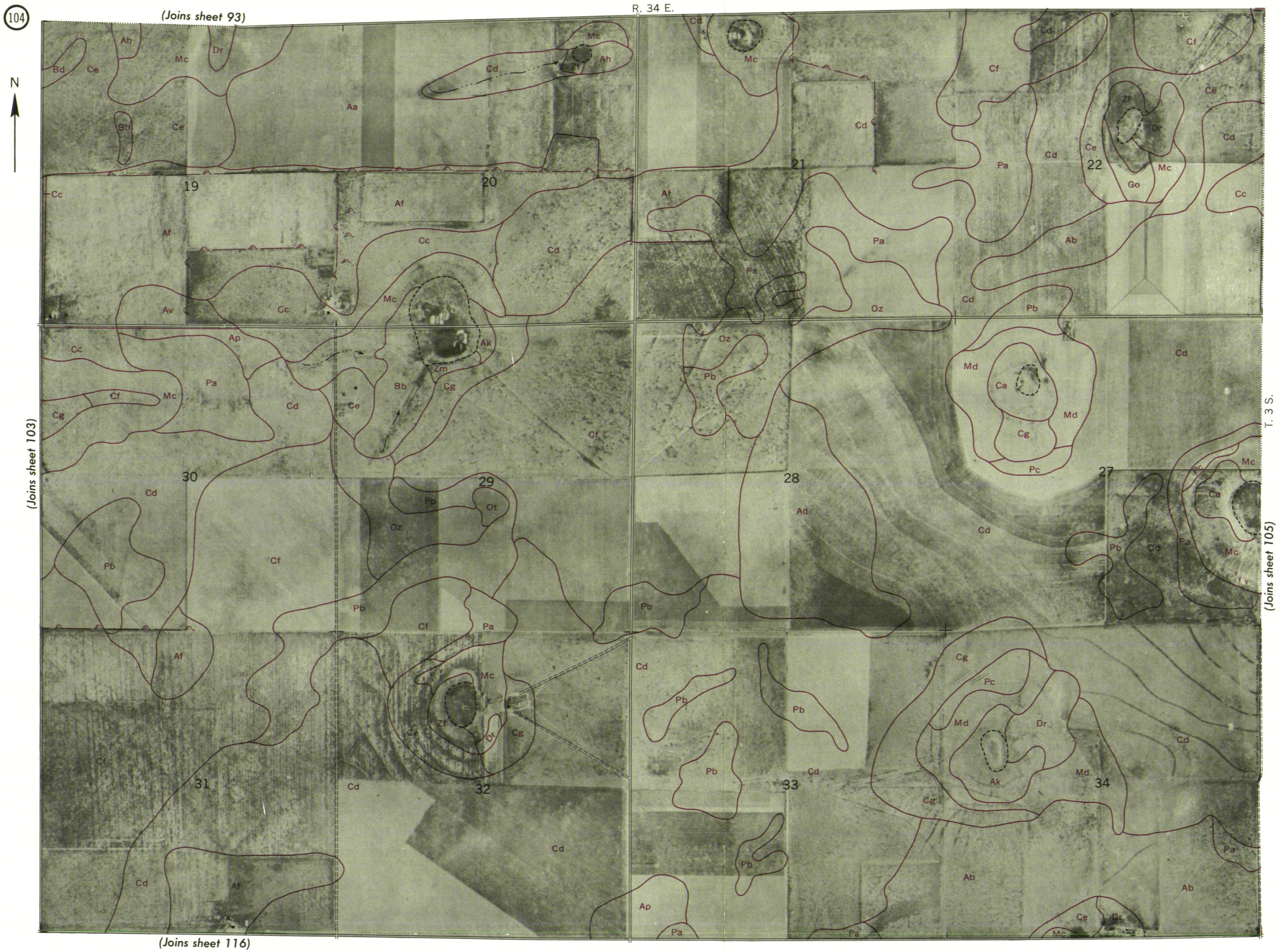

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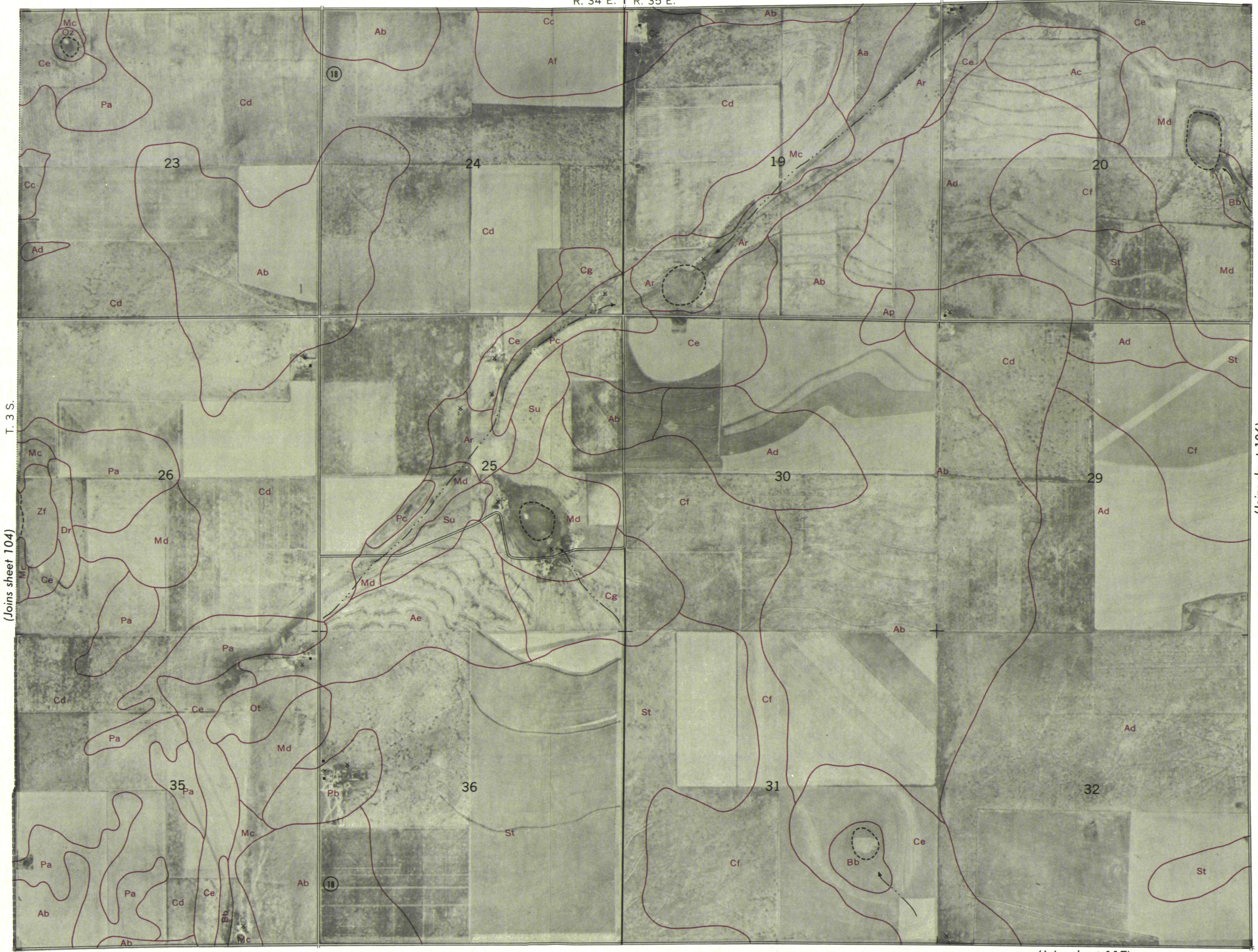

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


106
(Joins sheet 95)
R. 35 E.
N
(Joins sheet 105)
(Joins sheet 107)
(Joins sheet 118)
T. 3 S.
FIFTH GUIDE MERIDIAN EAST
21
22
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34
35
36
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

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Range, township, and section corners shown on this map are indefinite

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 108

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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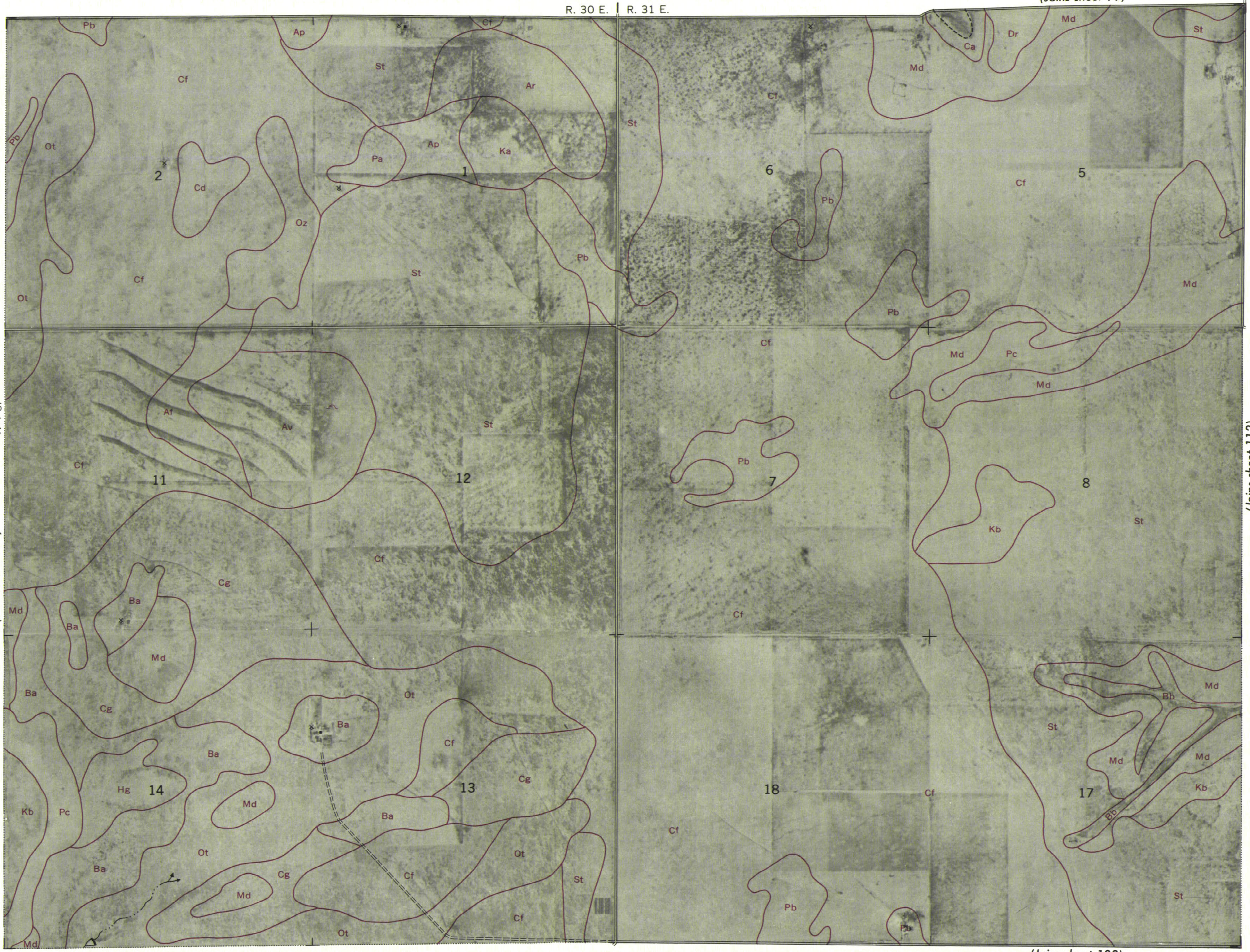
Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 110



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

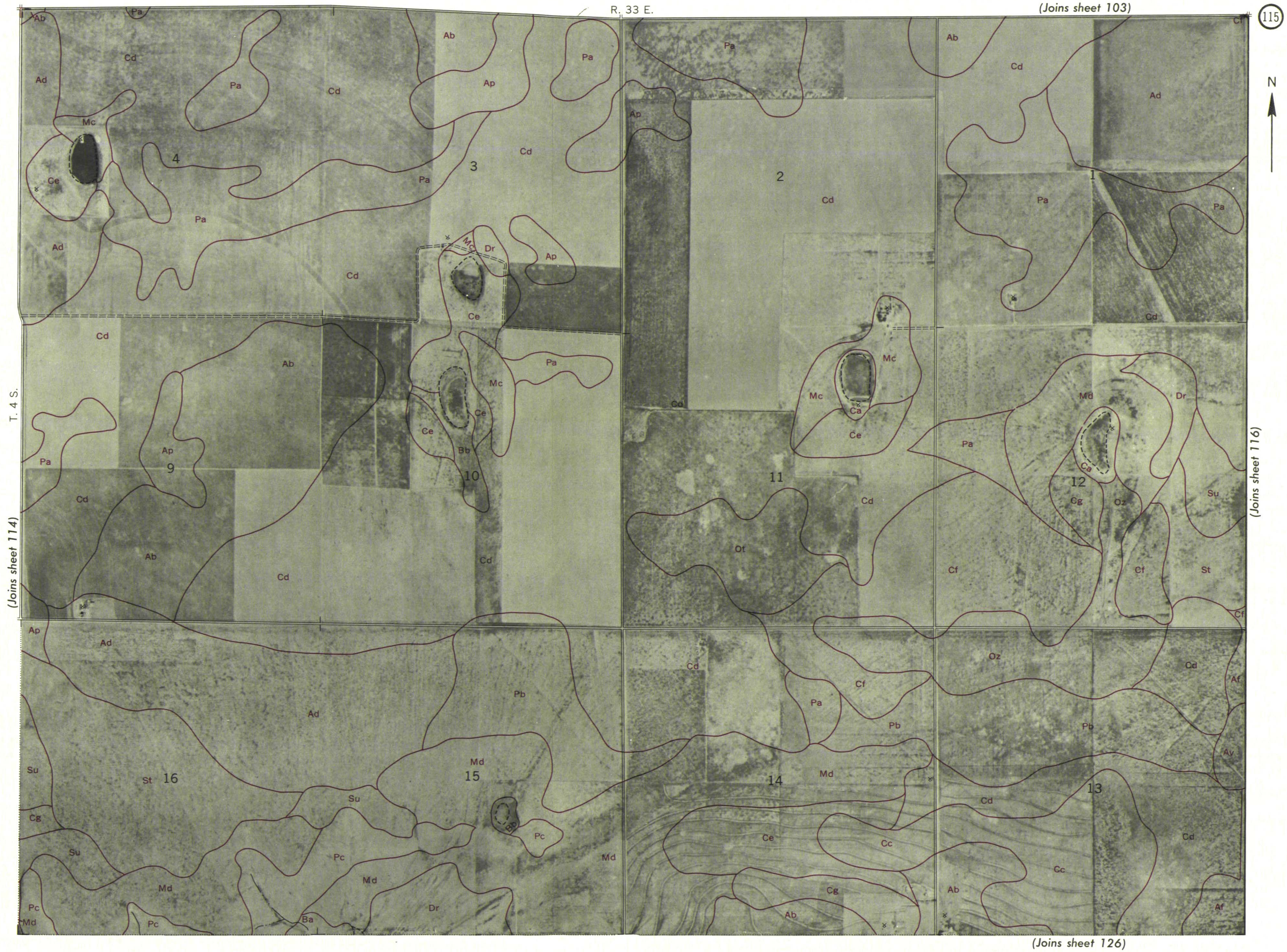
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


116
(Joins sheet 104)
R. 34 E.
N
(Joins sheet 115)
T. 4 S.
(Joins sheet 117)
(Joins sheet 127)
Cf
Cd
Ad
Af
Ab
Pa
Mc
Dr
Bb
Ce
Ak
Zf
Cc
Md
Su
St
Ot
Pc
Pb
Cg
Av
Ah
6
5
4
3
7
8
9
10
18
17
16
15
0
½
1 Mile
Scale 1: 20 000
5000 Feet

117

R. 34 E. | R. 35 E.

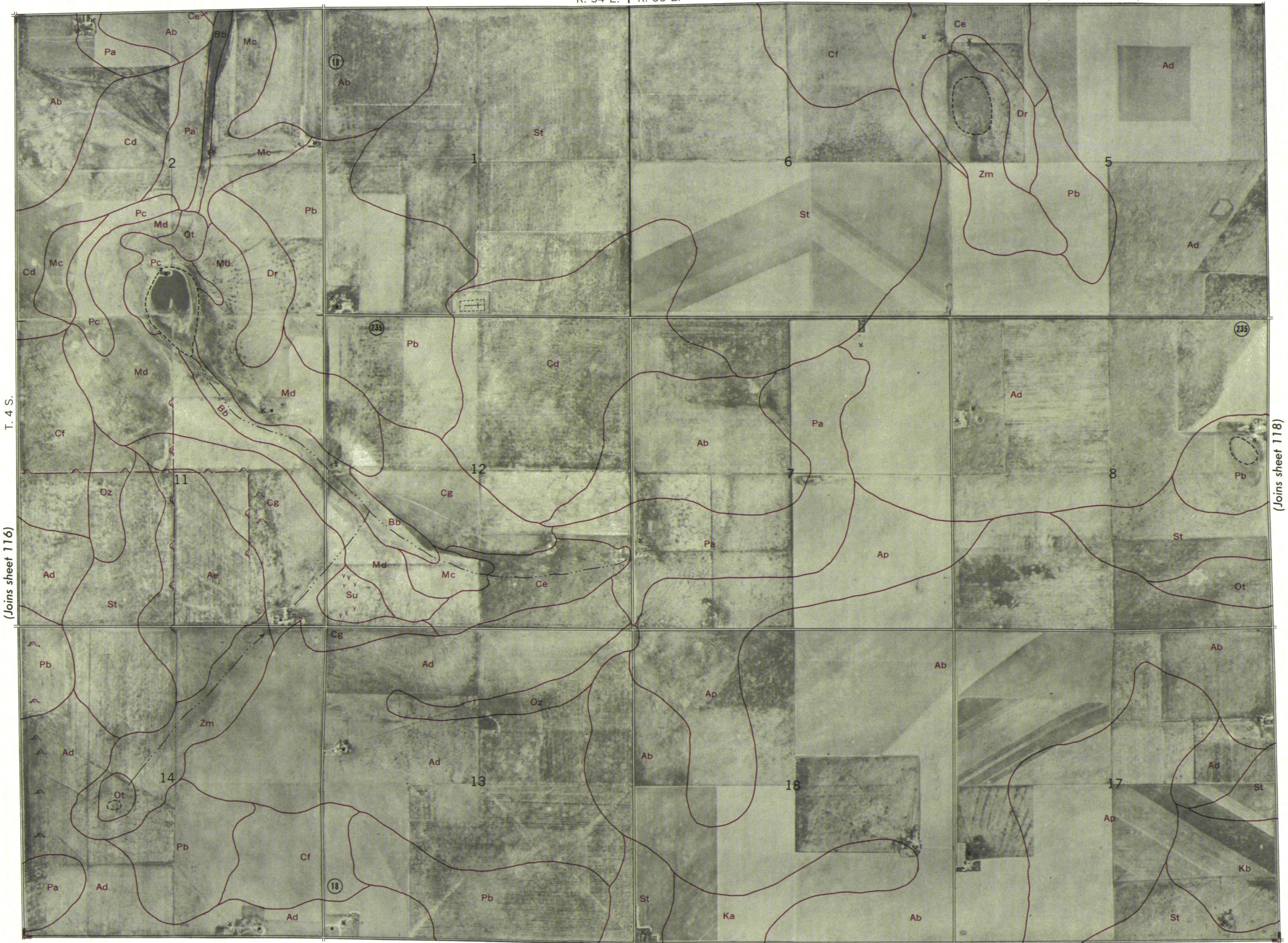
(Joins sheet 105)

N

T. 4 S.

(Joins sheet 116)

(Joins sheet 118)



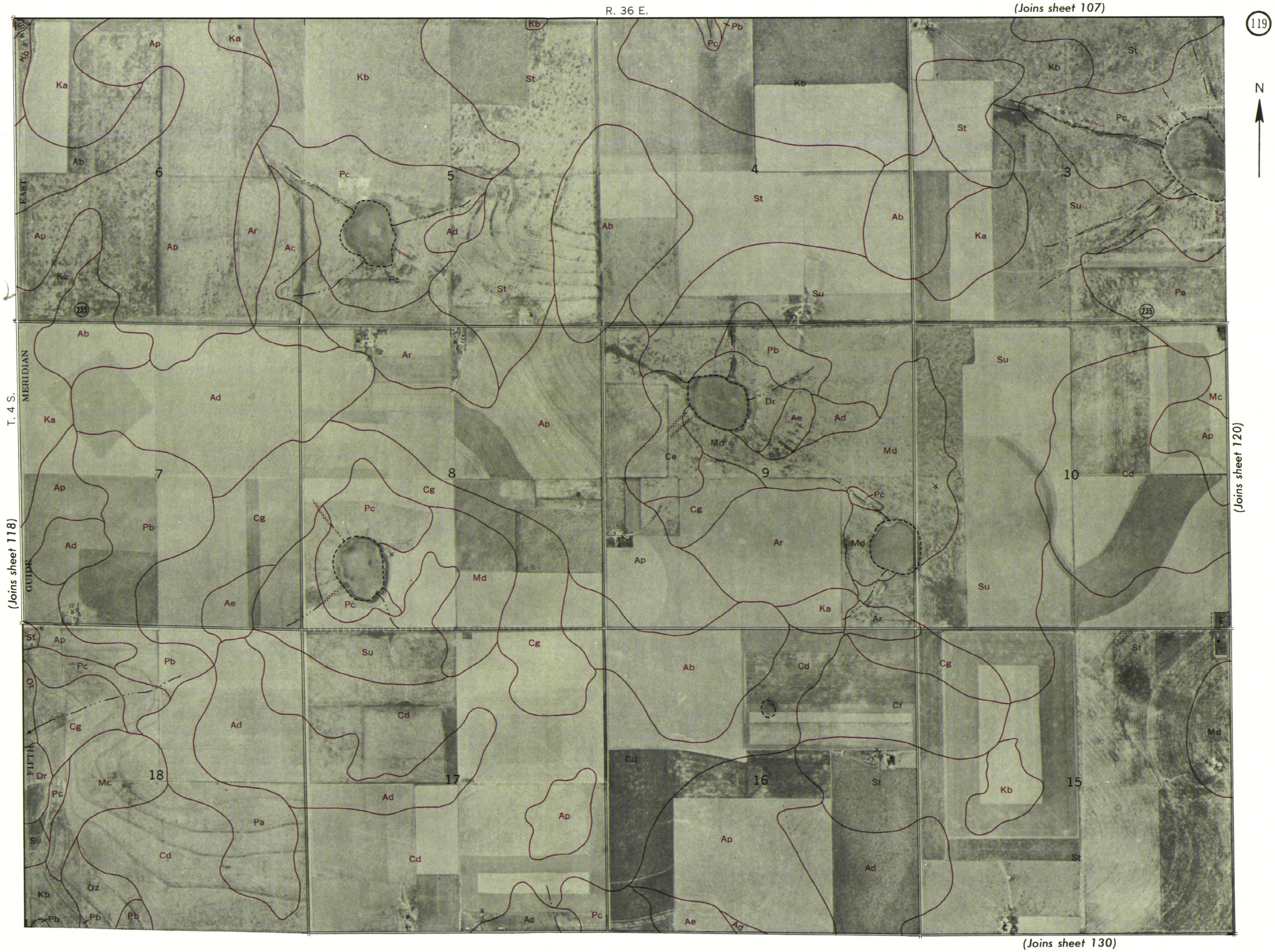
(Joins sheet 128)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


118
(Joins sheet 106)
R. 35 E.
N
(Joins sheet 117)
(Joins sheet 119)
(Joins sheet 129)
Rogers
EAST
MERIDIAN
GUIDE
FIFTH
T. 4 S.
235
1
2
3
4
9
10
11
12
13
14
15
16
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

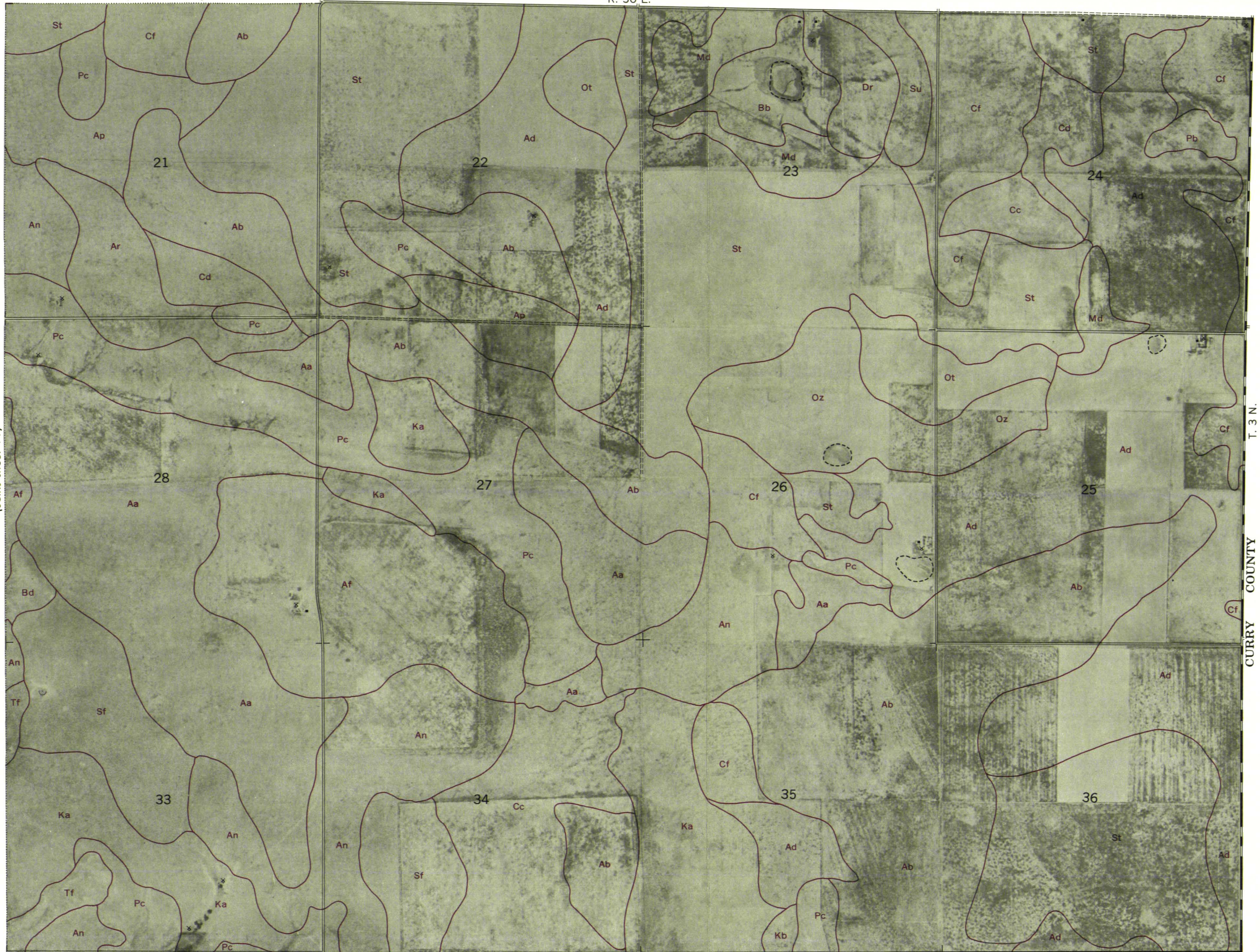
Range, township, and section corners shown on this map are indefinite.

12

(Joins sheet 9)

R. 30 E.

N



(Joins sheet 11)

T. 3 N.

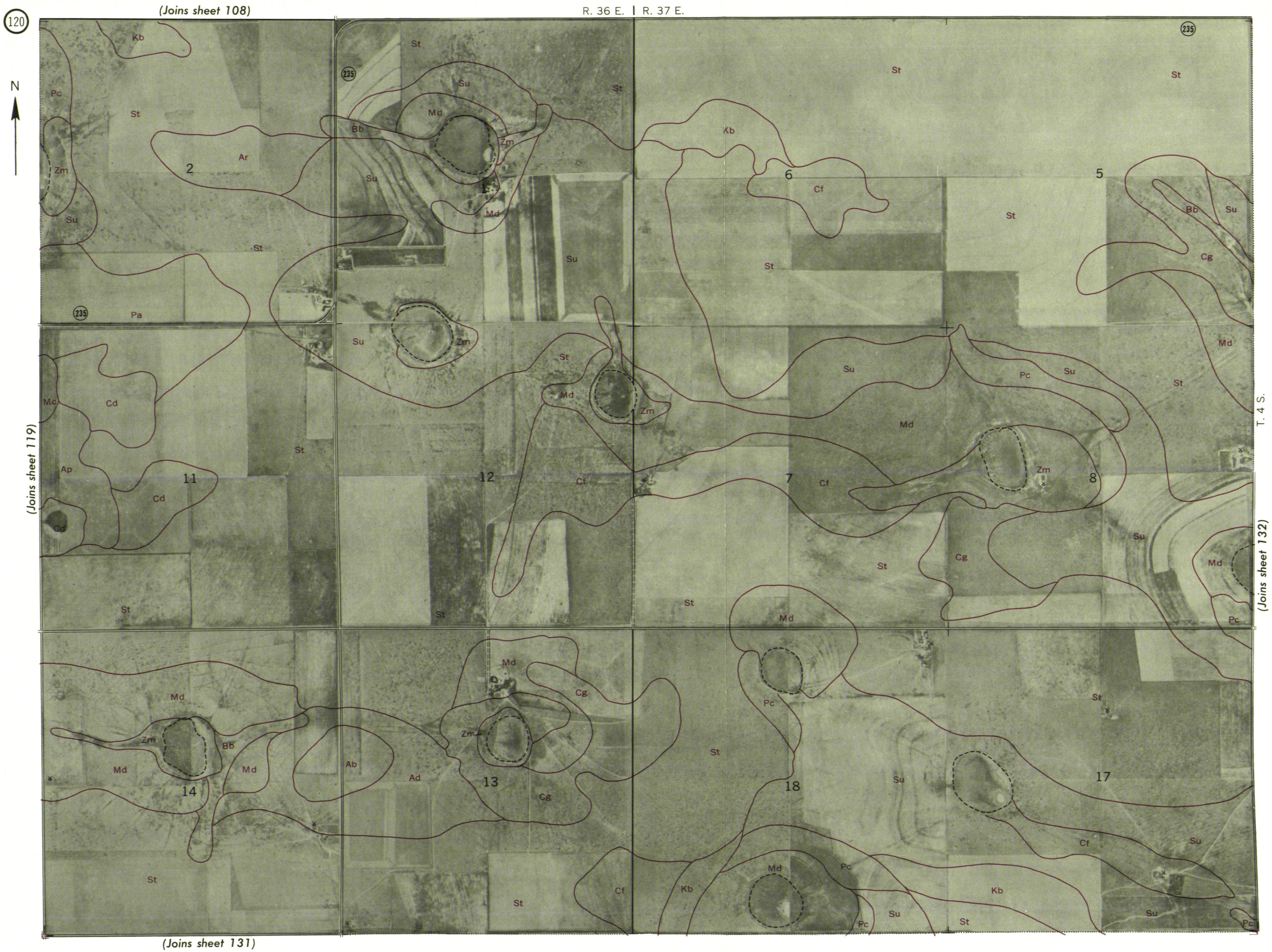
CURRY COUNTY

(Joins sheet 15)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

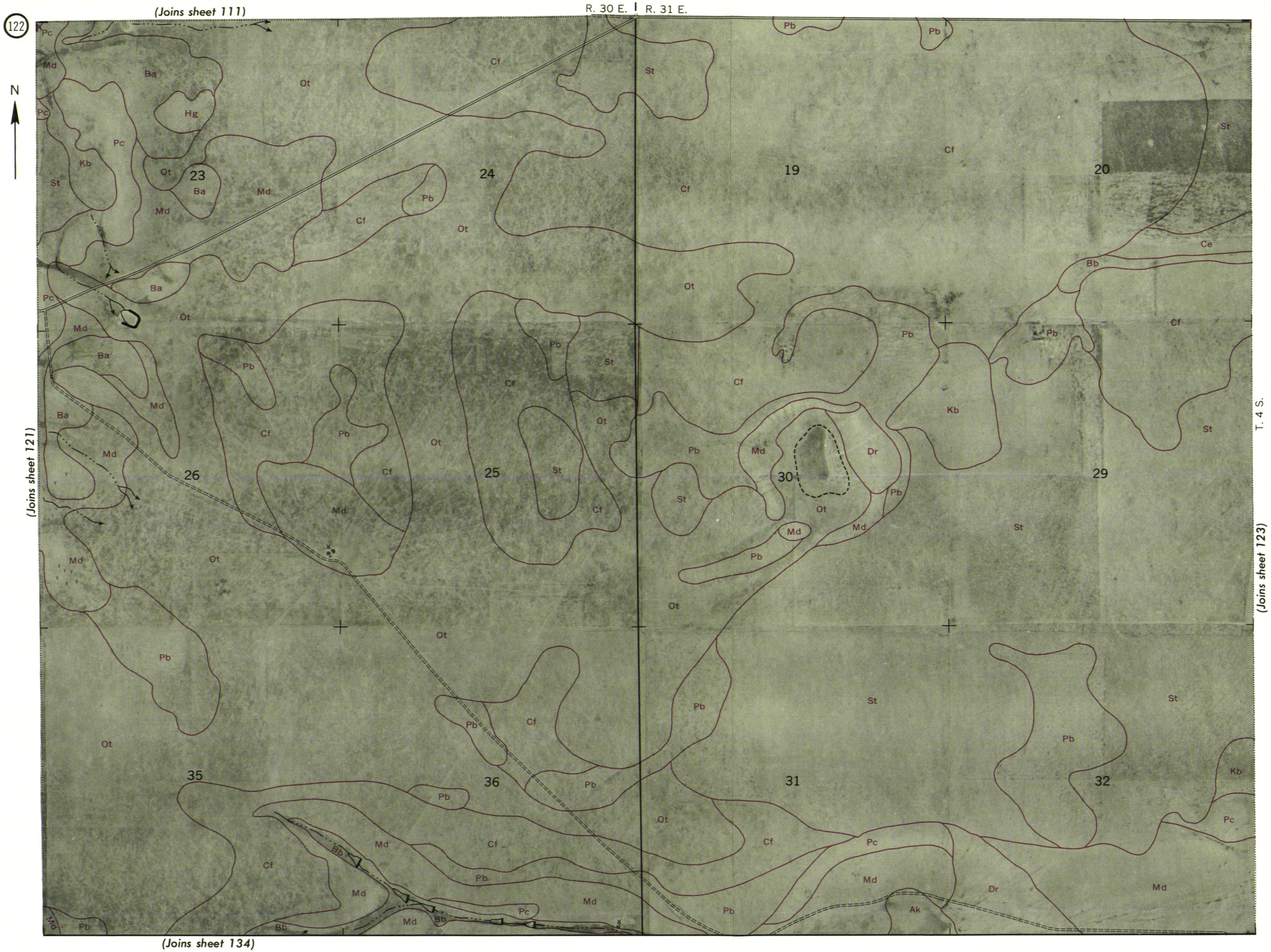


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

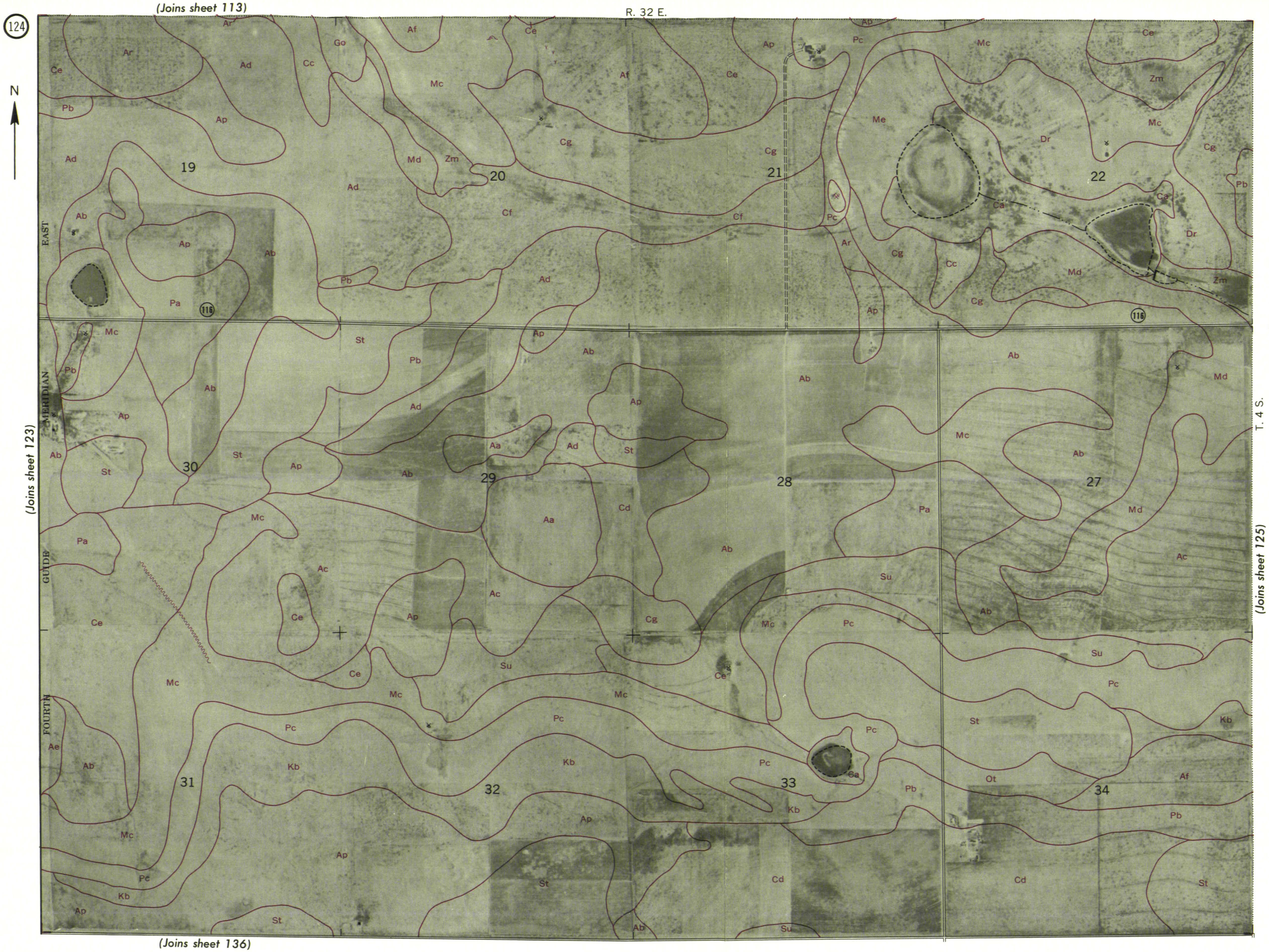
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

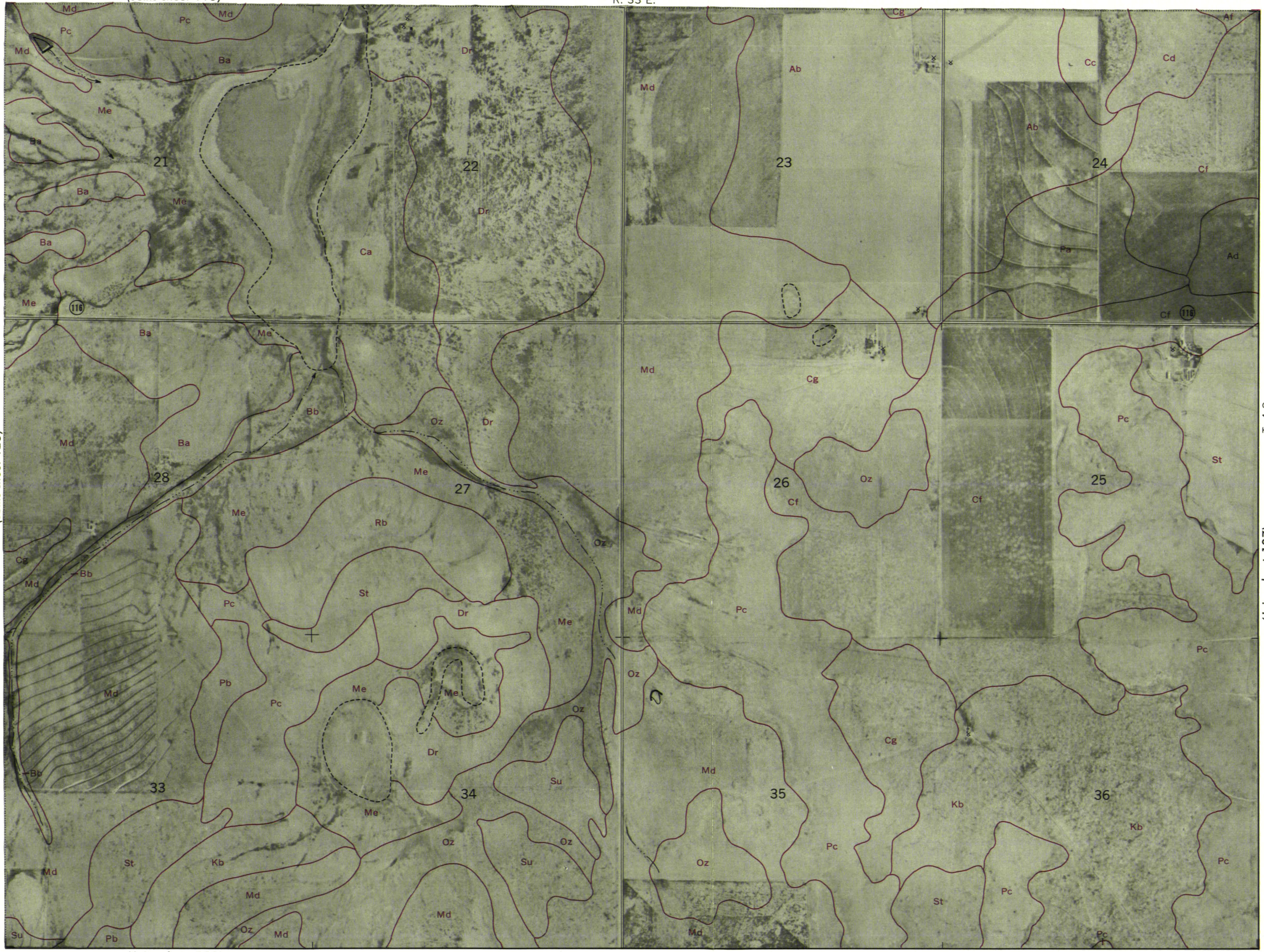
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

126

(Joins sheet 115)



(Joins sheet 138)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


128
(Joins sheet 117)
R. 34 E.
R. 35 E.
N
(Joins sheet 127)
(Joins sheet 129)
T. 4 S.
(Joins sheet 140)
DORA
23
24
19
20
26
25
30
29
35
36
31
32
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

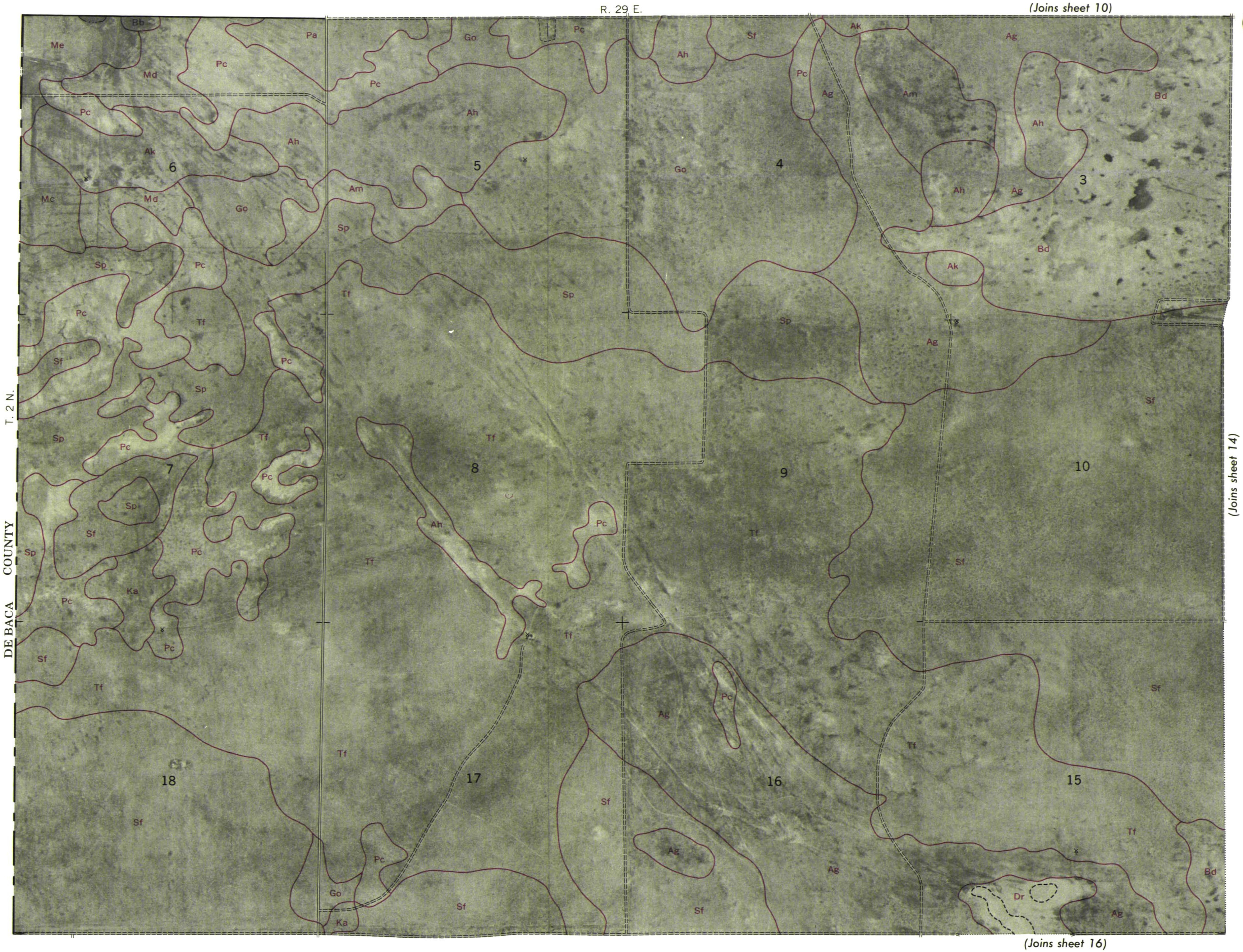
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

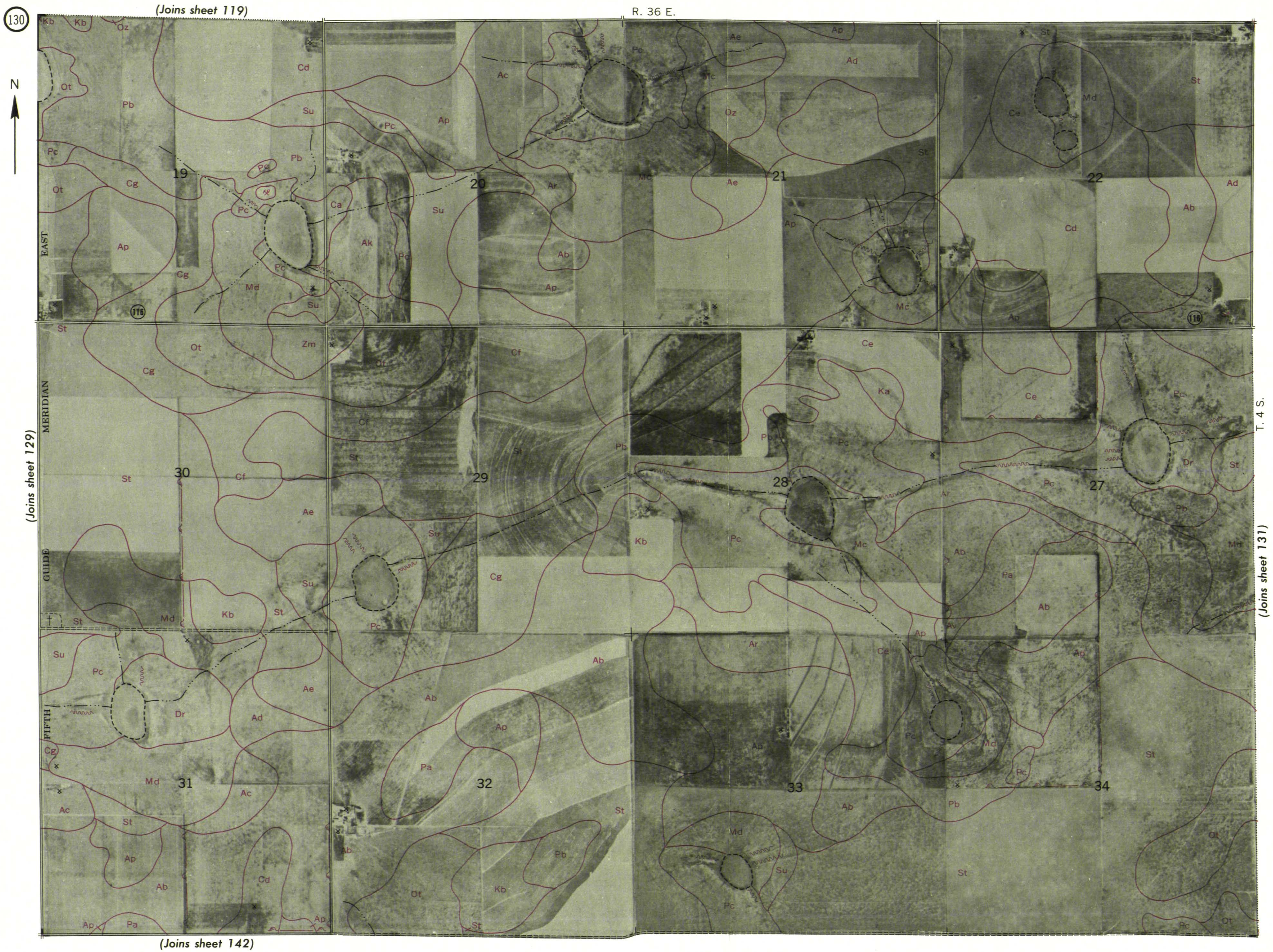
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

132

N

(Joins lower right)

(Joins inset, sheet 155)

(Joins sheet 109)

(Joins upper left)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

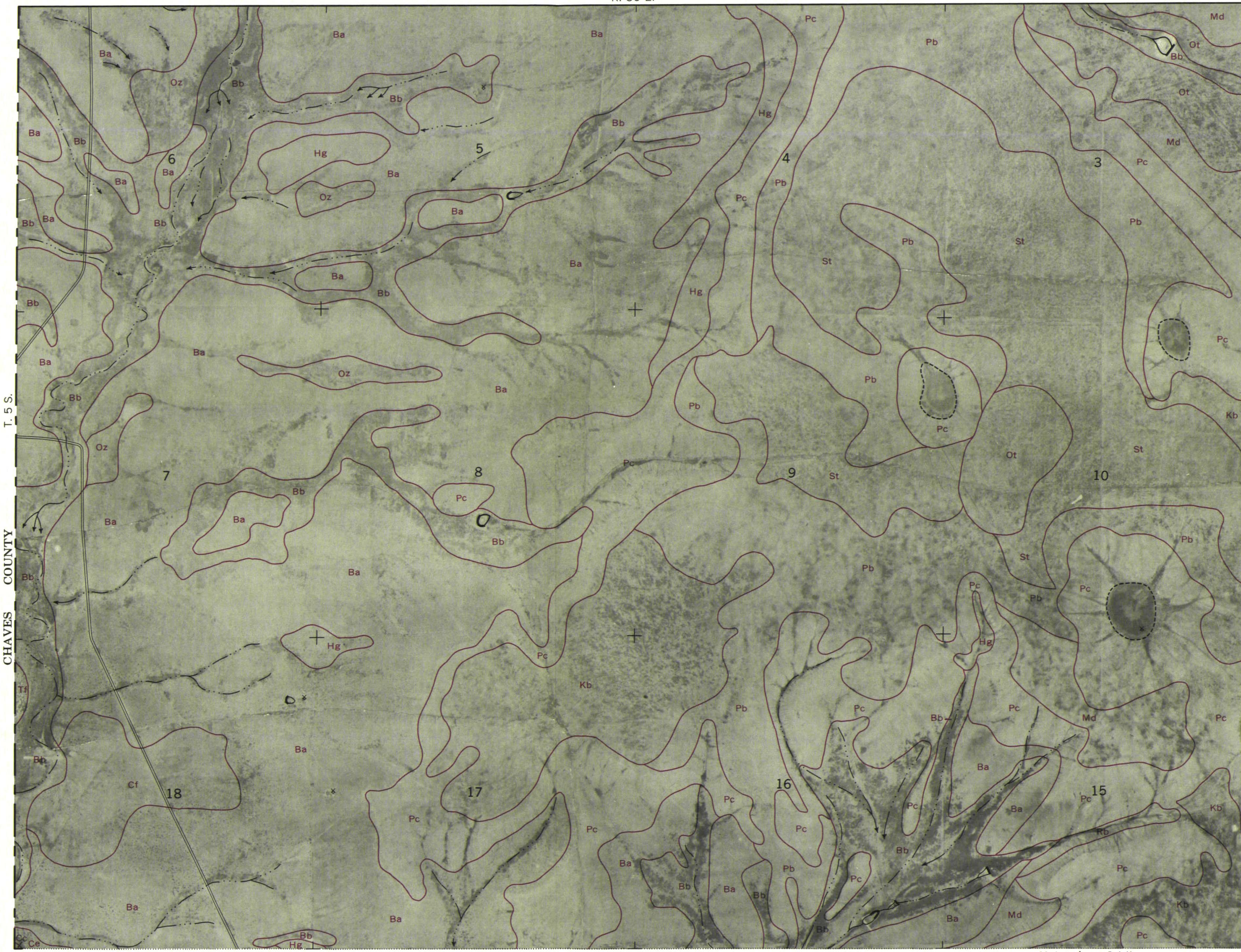
133

R. 30 E.

(Joins sheet 121)

T. 5 S.

CHAVES COUNTY



(Joins sheet 134)

(Joins sheet 144)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


134
N
(Joins sheet 122)
R. 30 E. | R. 31 E.
(Joins sheet 133)
(Joins sheet 135)
T. 5 S.
(Joins sheet 145)
ATCHISON
TOPEKA
AND
SANTA FE
70
1
2
5
6
7
8
11
12
13
14
17
18
Pb
Md
Cf
Ot
Bb
Ba
Pc
Ak
Dr
Ca
Oz
St
Kb
Cg
Su
Hg
Me
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

(Joins sheet 123)

(Joins sheet 134)

(Joins sheet 136)

(Joins sheet 146)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

136

(Joins sheet 124)

(Joins sheet 135)

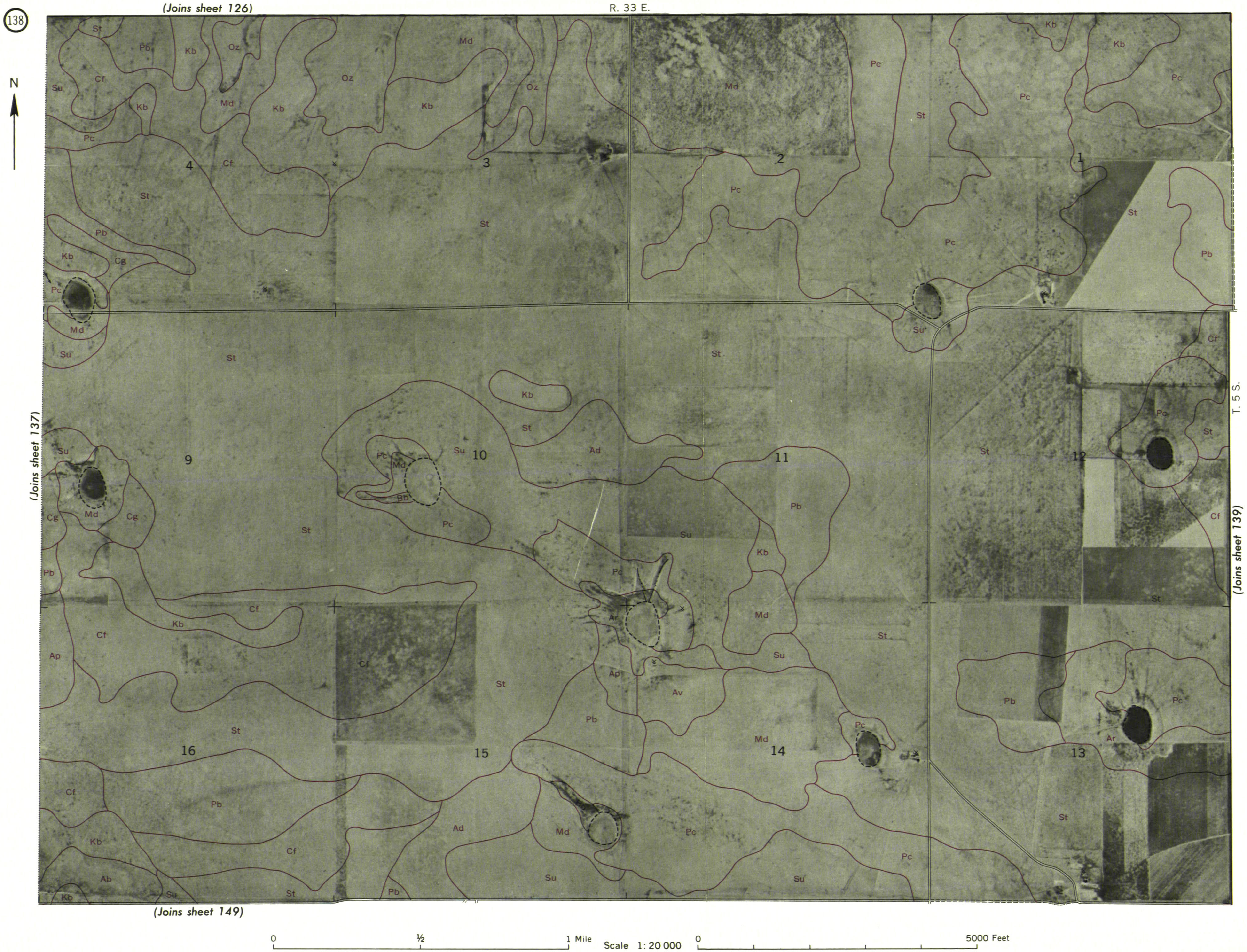
(Joins sheet 137)

(Joins sheet 147)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

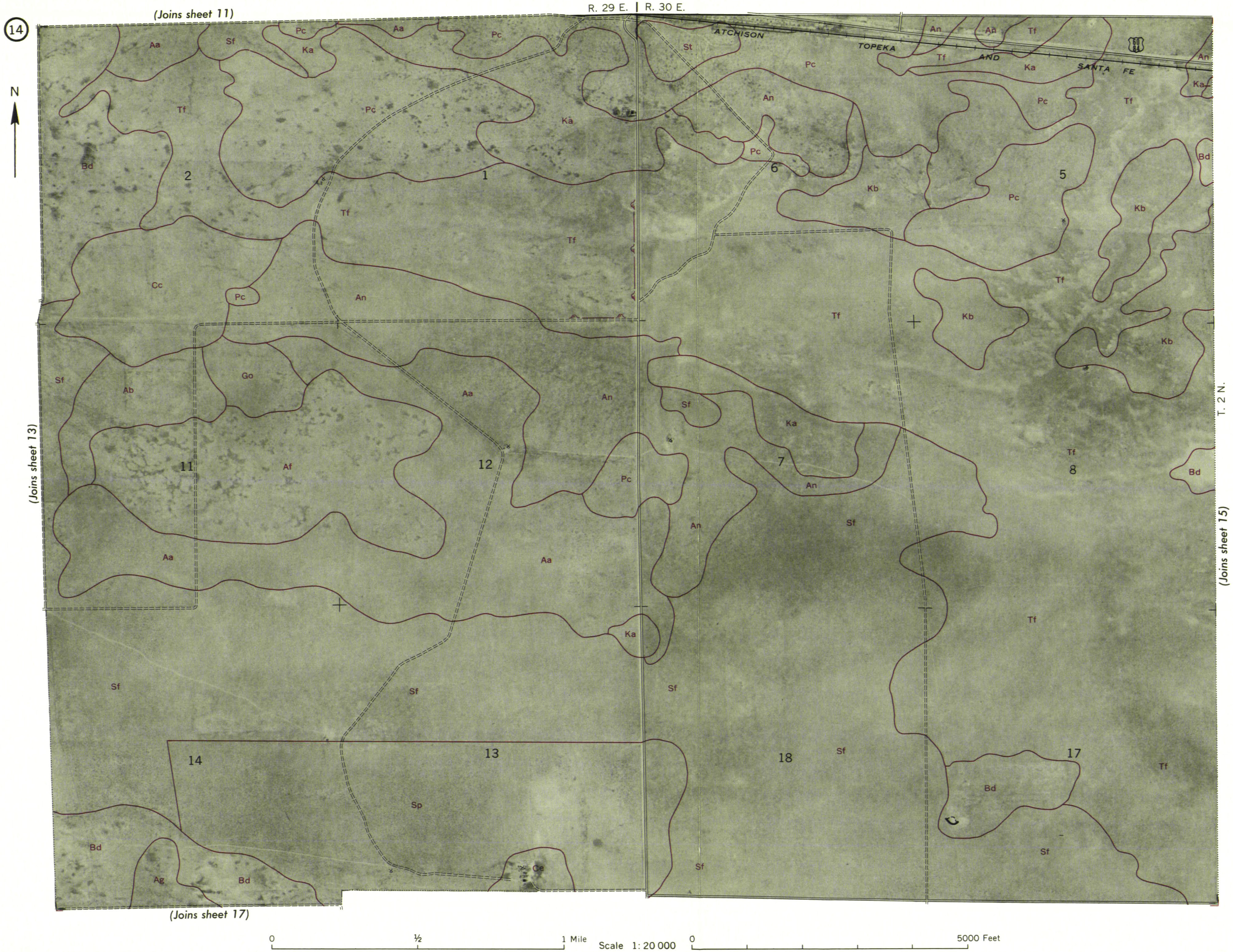
Range, township, and section corners shown on this map are indefinite


138
(Joins sheet 126)
R. 33 E.
N
(Joins sheet 137)
(Joins sheet 139)
T. 5 S.
(Joins sheet 149)
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

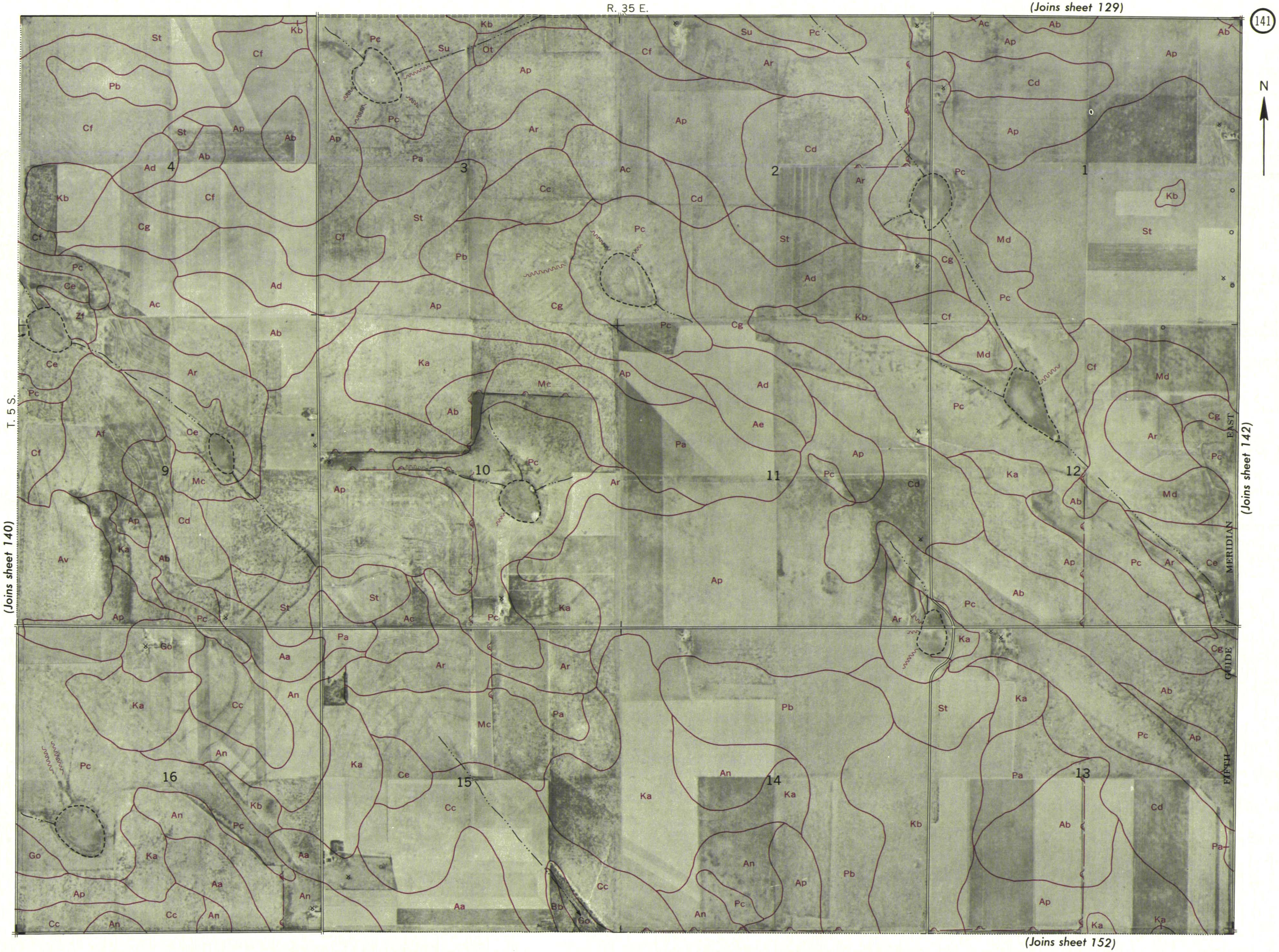
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



14
(Joins sheet 11)
R. 29 E.
R. 30 E.
N
ATCHISON
TOPEKA
AND
SANTA FE
T. 2 N.
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 17)
1
2
5
6
7
8
11
12
13
14
17
18
Aa
Ab
Af
Ag
An
Bd
Cc
Ce
Go
Ka
Kb
Pc
Sf
Sp
St
Tf
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

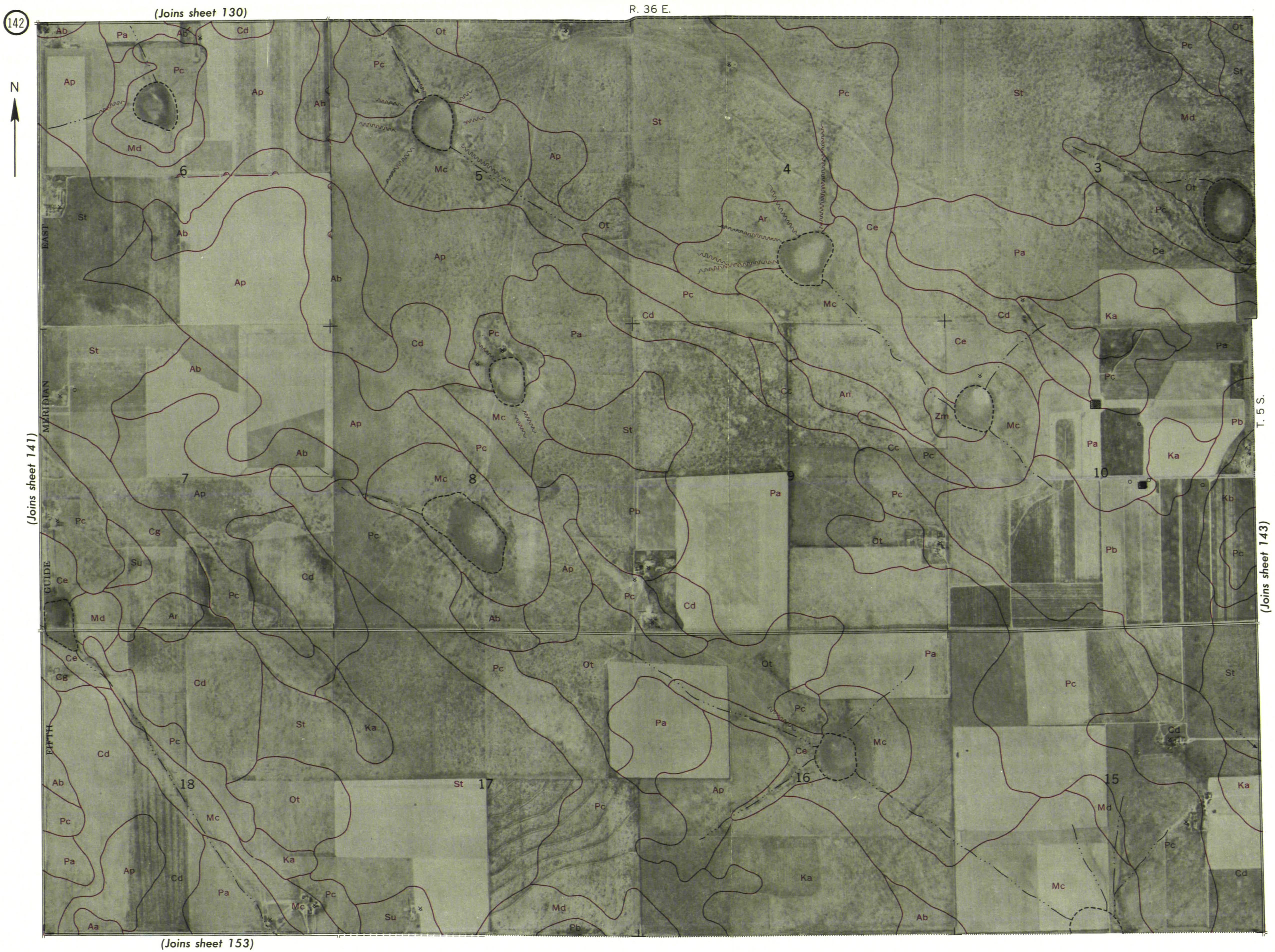

140
(Joins sheet 128)
R. 34 E. | R. 35 E.
N
(Joins sheet 139)
(Joins sheet 141)
T. 5 S.
(Joins sheet 151)
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

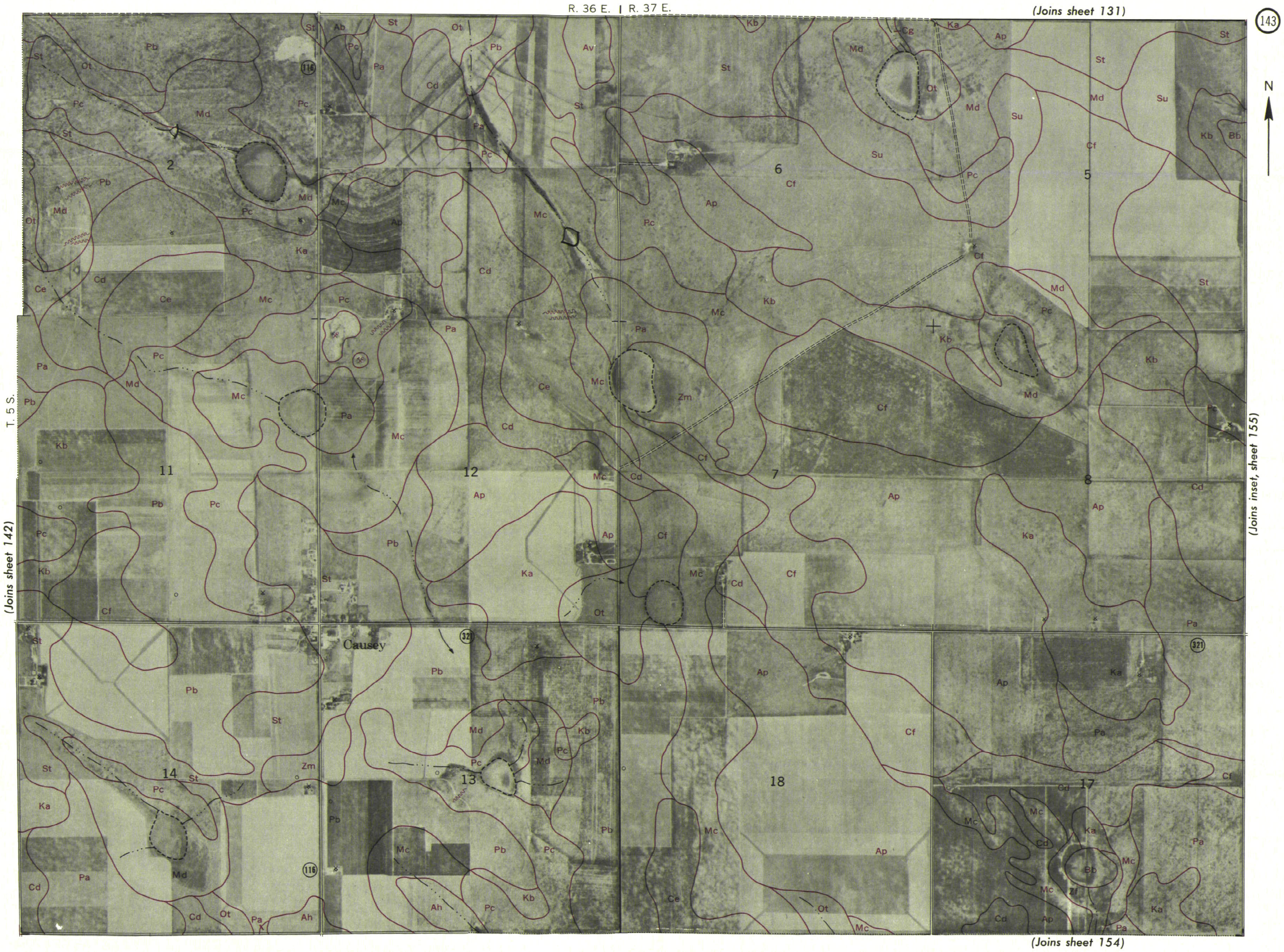
Range, township, and section corners shown on this map are indefinite.



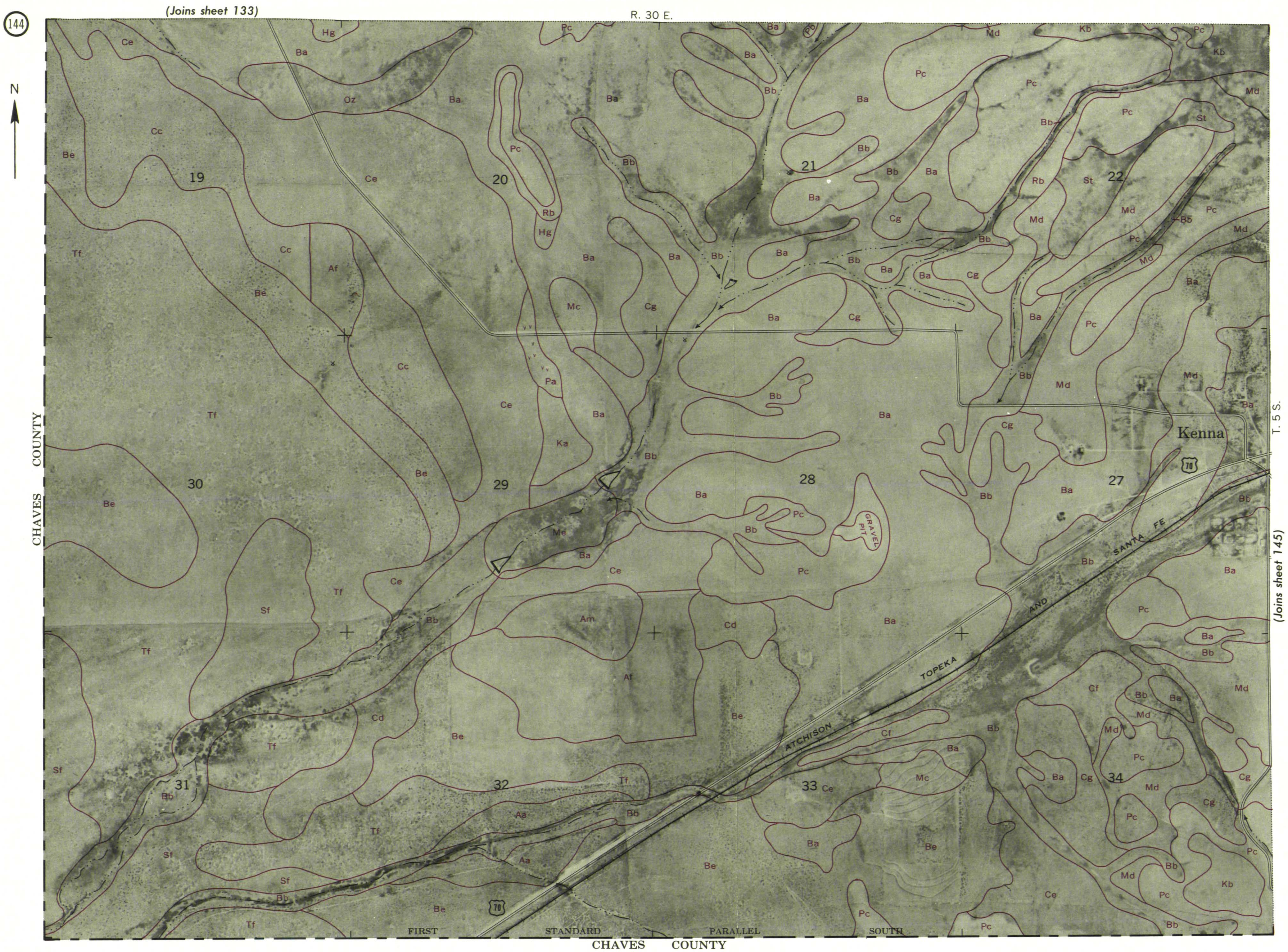
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

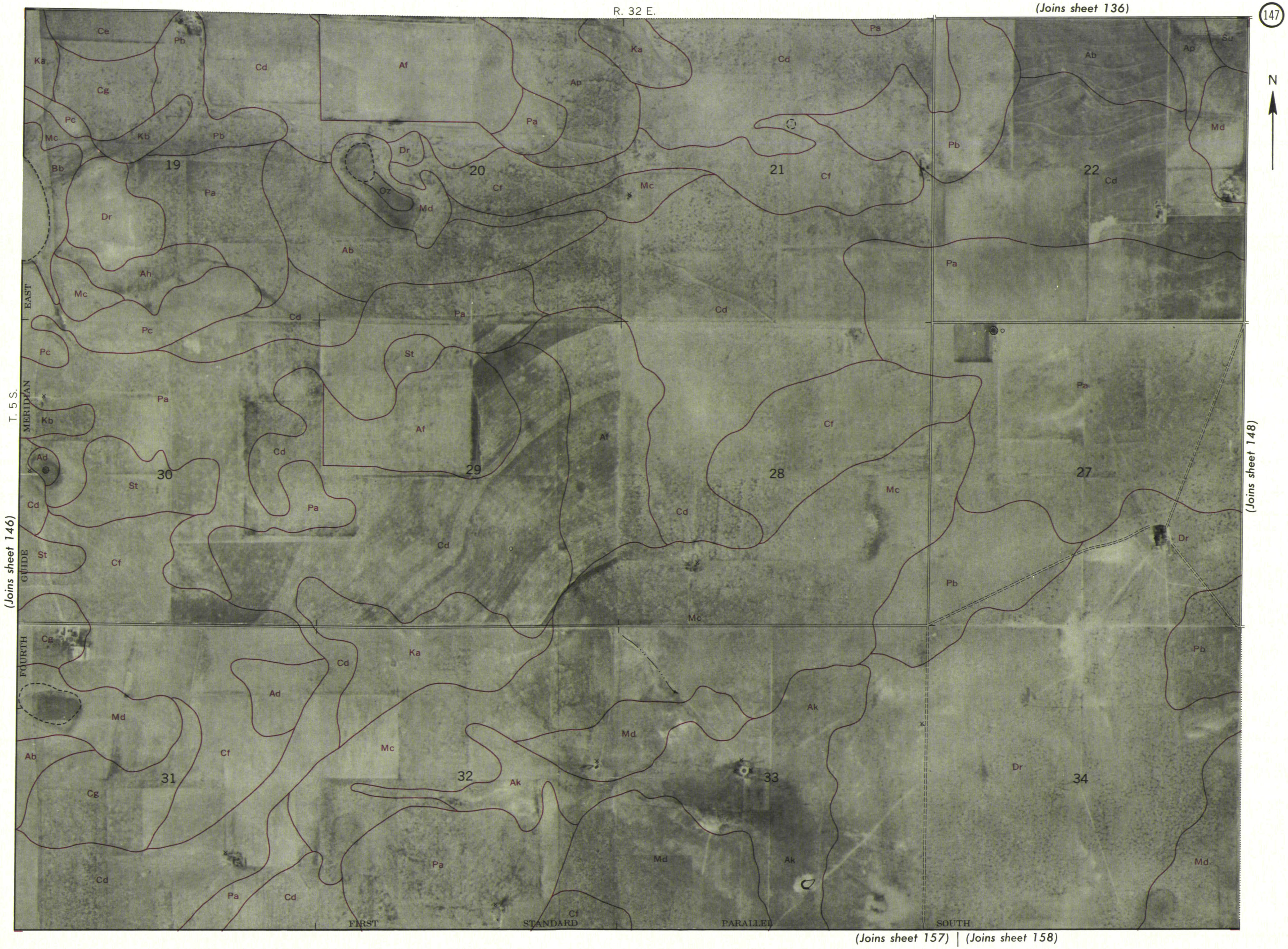
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 145

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite


146
(Joins sheet 135)
R. 31 E.
N
(Joins sheet 145)
(Joins sheet 147)
T. 5 S.
FOURTH GUIDE MERIDIAN EAST
FIRST STANDARD PARALLEL SOUTH
(Joins sheet 156)
(Joins sheet 157)
440
21
22
23
24
25
26
27
28
33
34
35
36
Md
Bb
Pc
St
Cf
Pb
Ae
Su
Ce
Ac
Ka
Mc
Dr
Pa
Kb
Cd
Cg
Ca
Ak
Ap
Af
Av
Ad
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet



Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

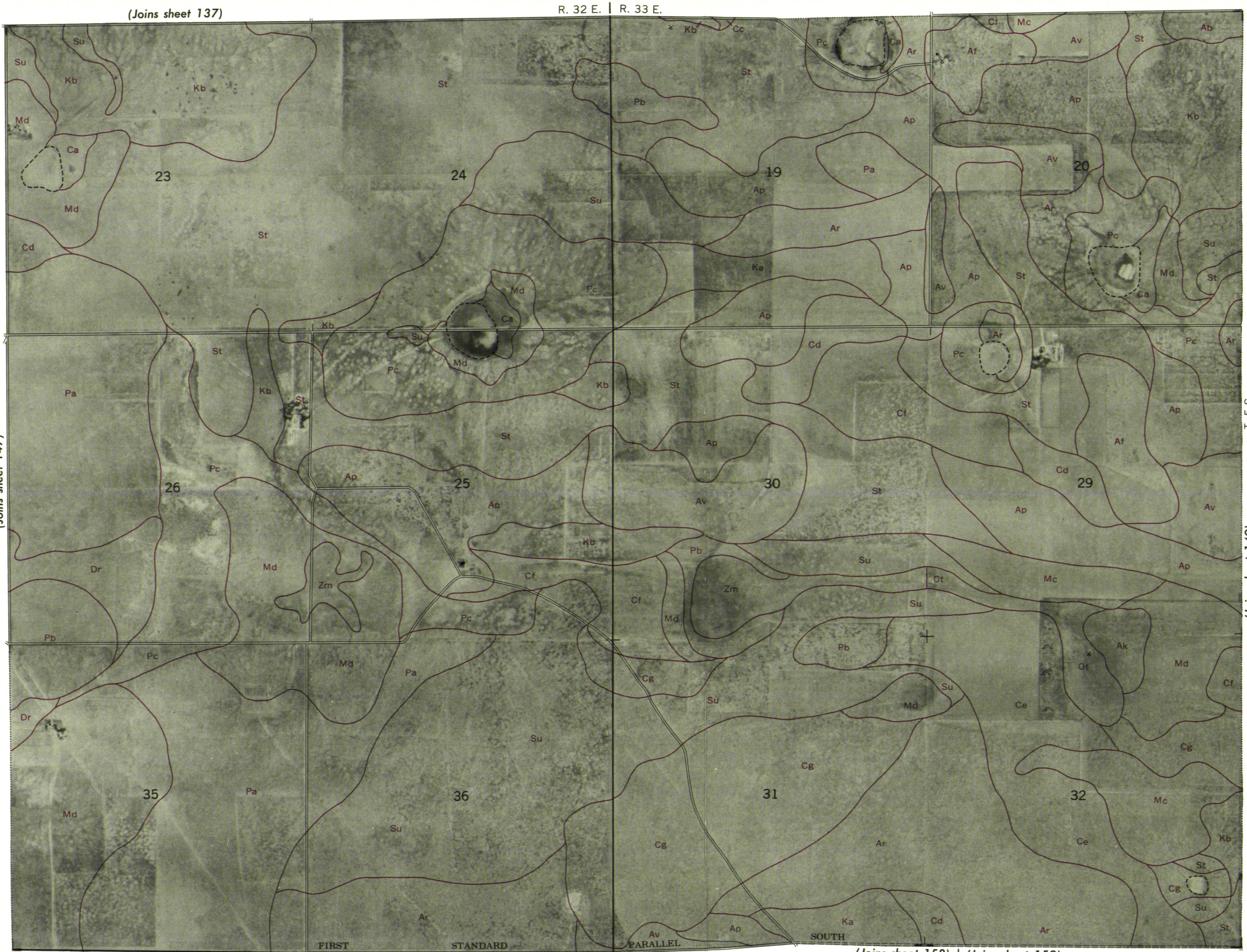
Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 148

148

(Joins sheet 137)

R. 32 E. | R. 33 E.



(Joins sheet 147)

(Joins sheet 149)

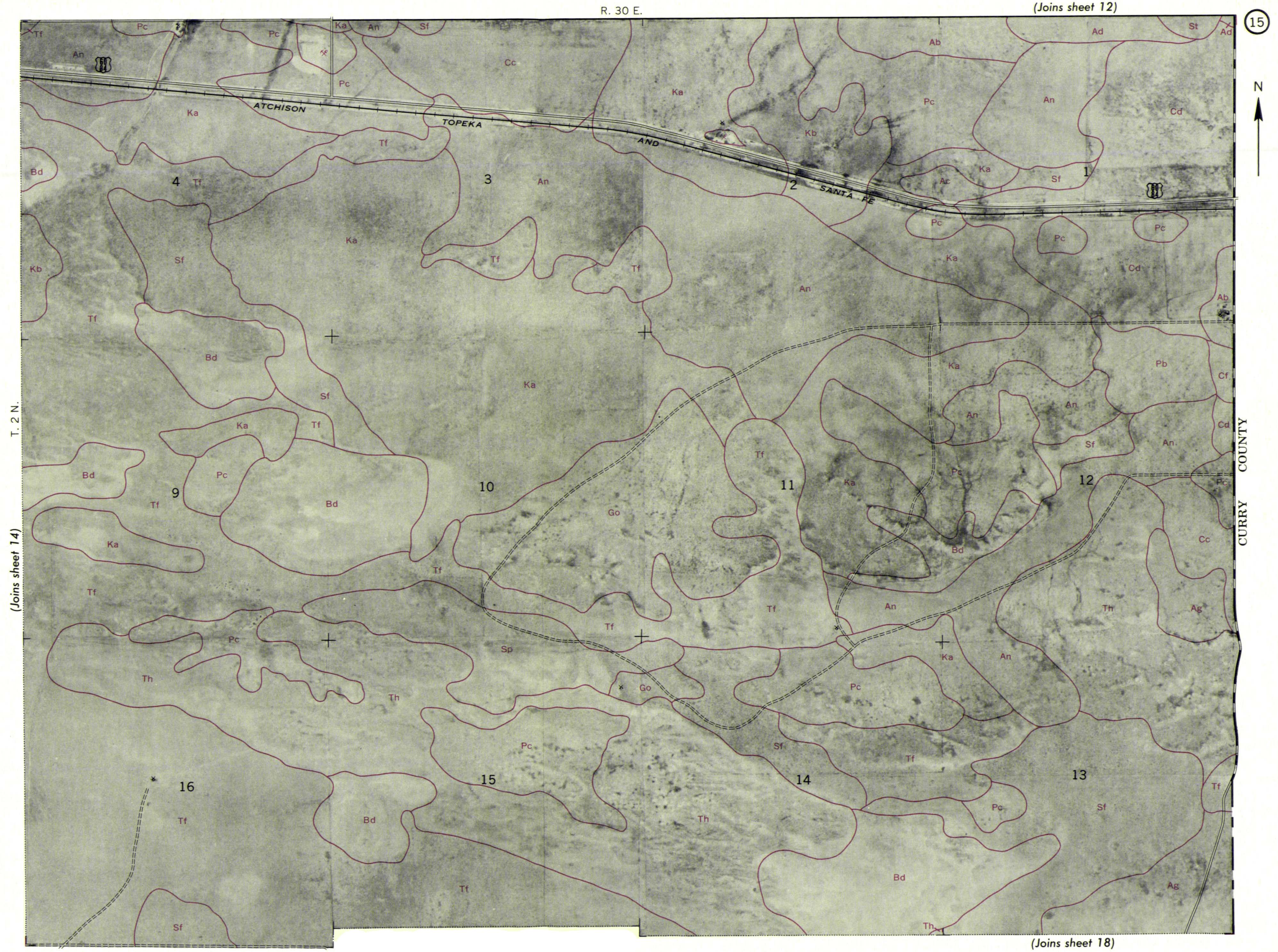
(Joins sheet 158) | (Joins sheet 159)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

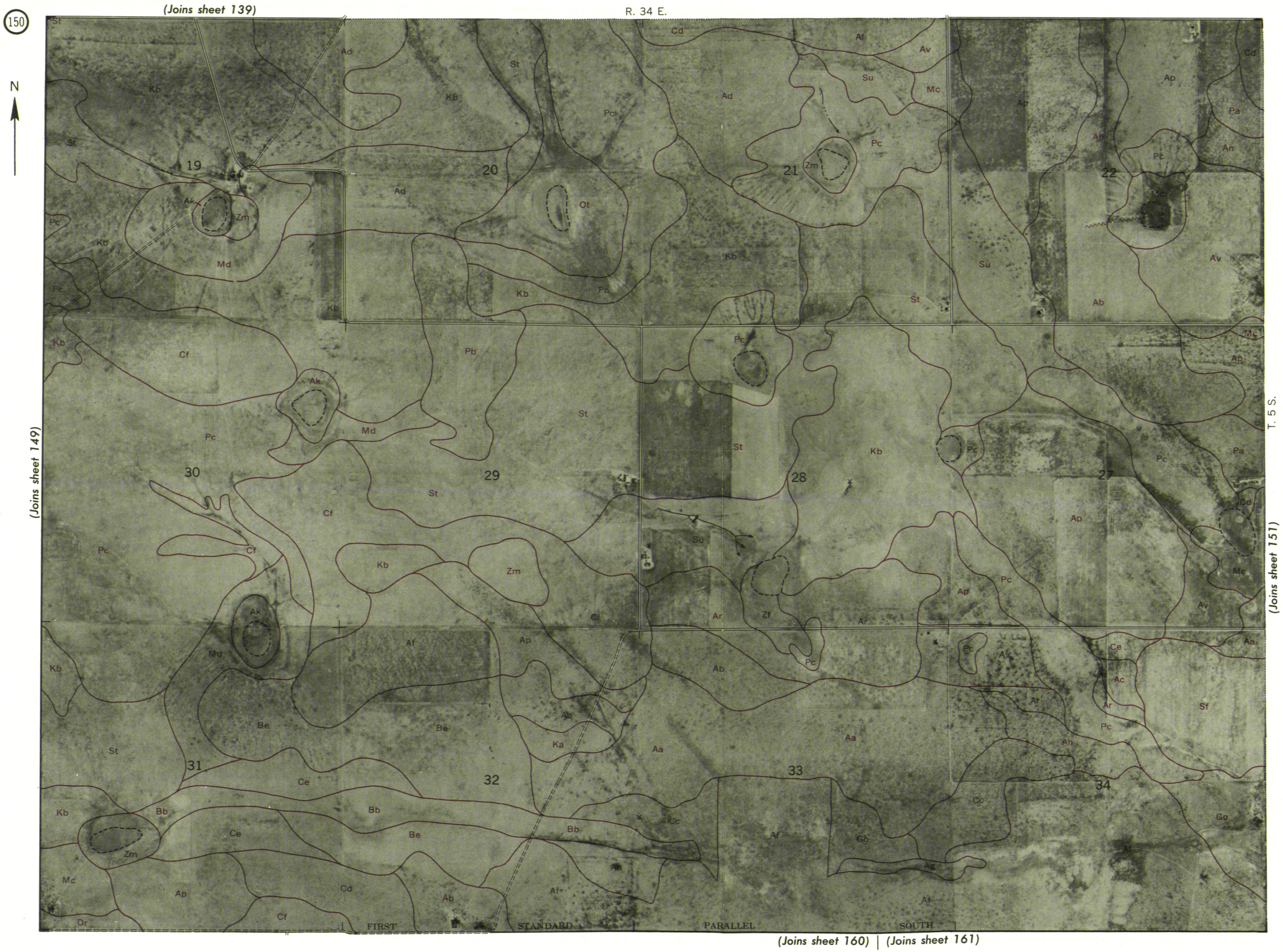
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

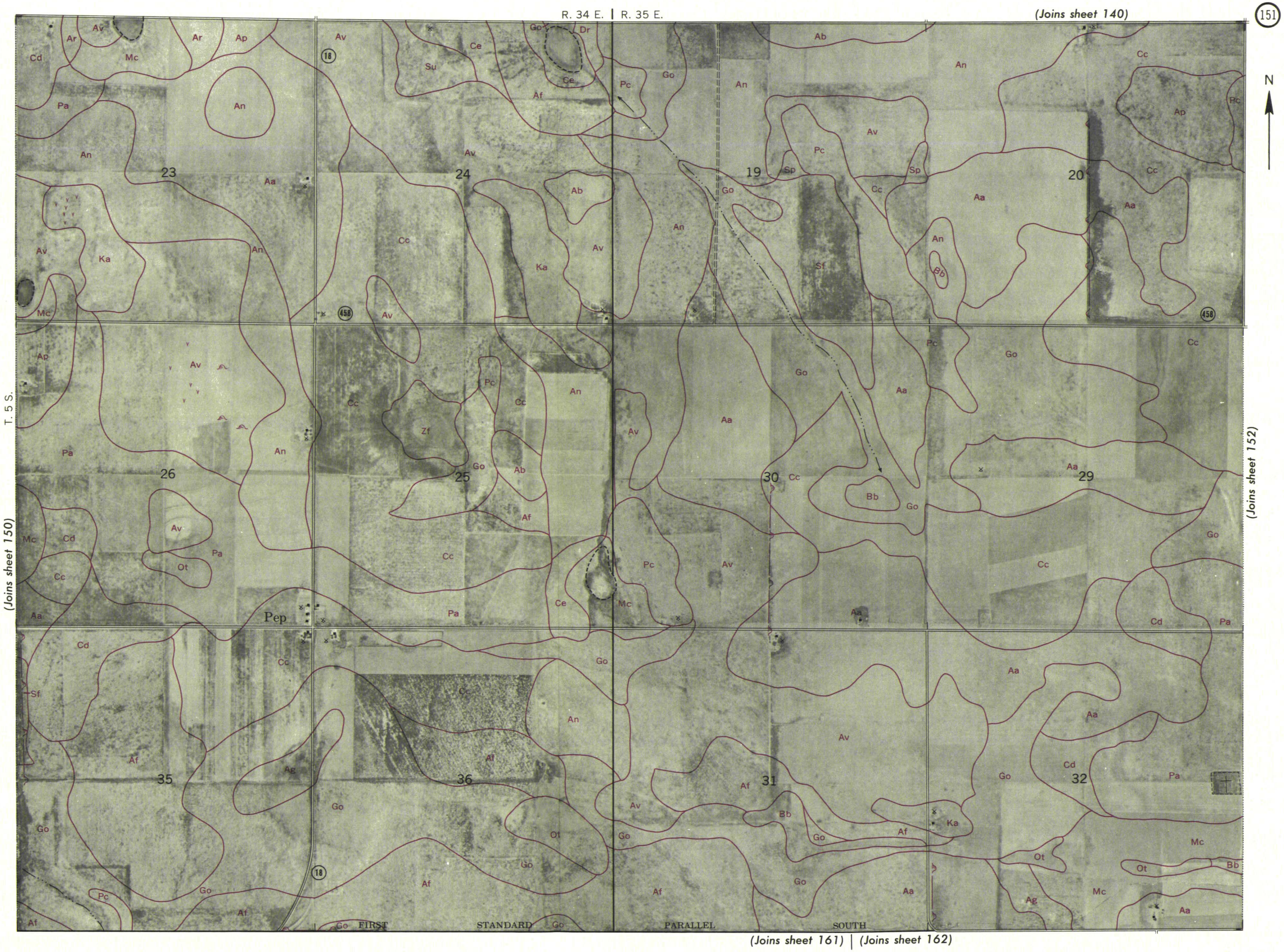


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 151

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


152
(Joins sheet 141)
R. 35 E.
N
(Joins sheet 151)
(Joins sheet 153)
T. 5 S.
21
22
23
24
28
27
26
25
33
34
35
36
Garrison
EAST
MERIDIAN
GUIDE
FIFTH
FIRST
STANDARD
PARALLEL
SOUTH
(Joins sheet 162) | (Joins sheet 163)
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

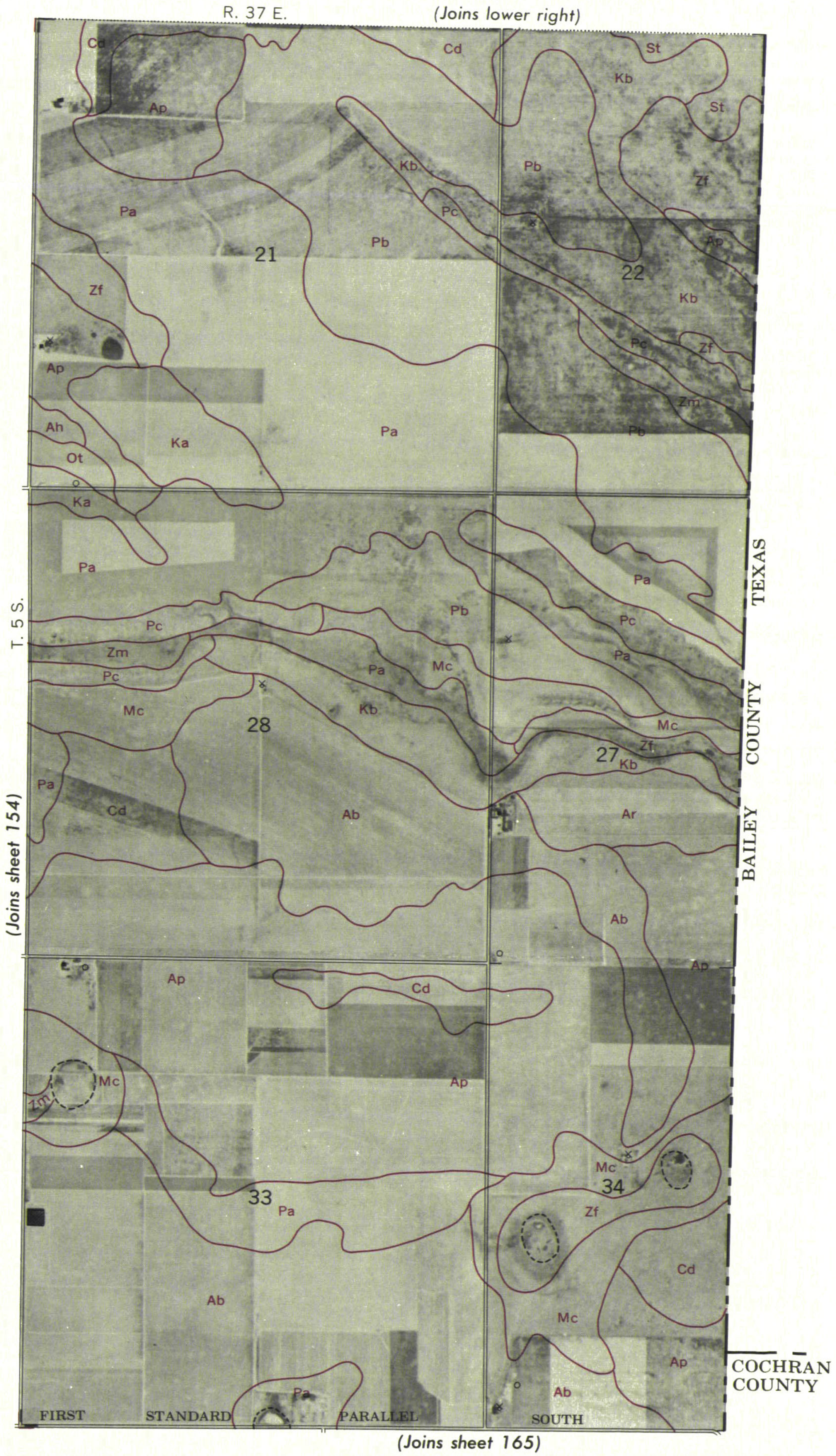
Range, township, and section corners shown on this map are indefinite.

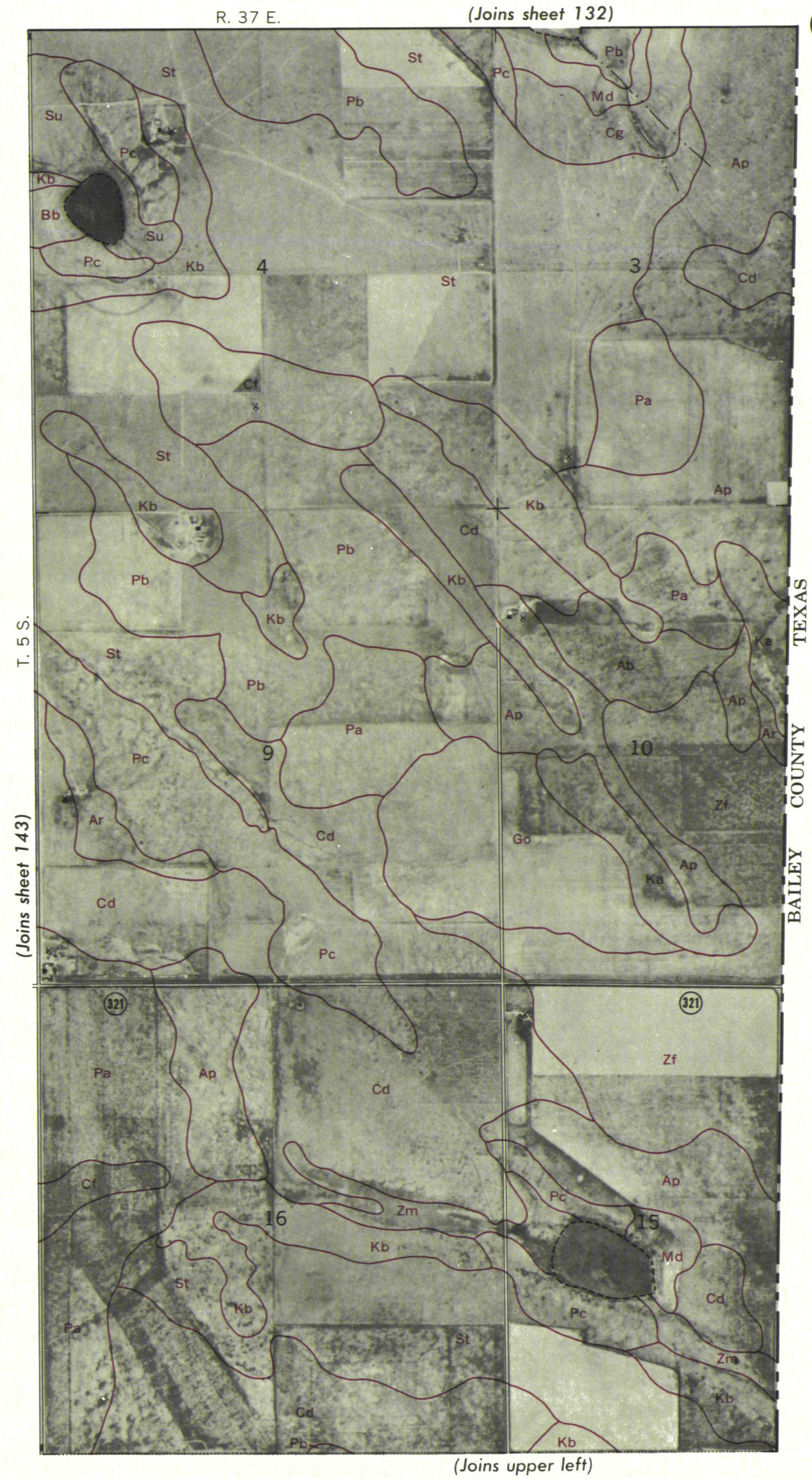
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 154

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.





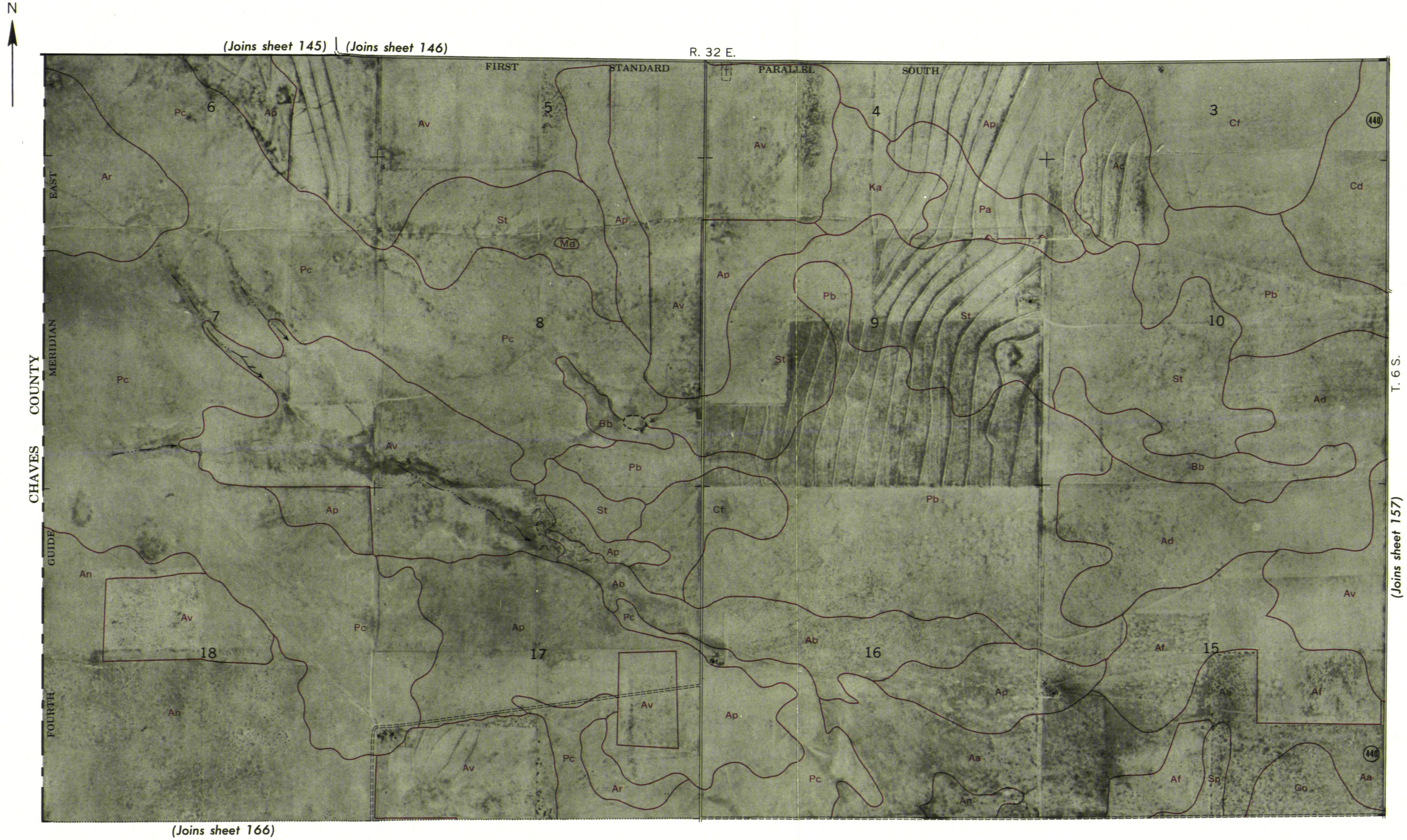
0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 156

156



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

157

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

N

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

158

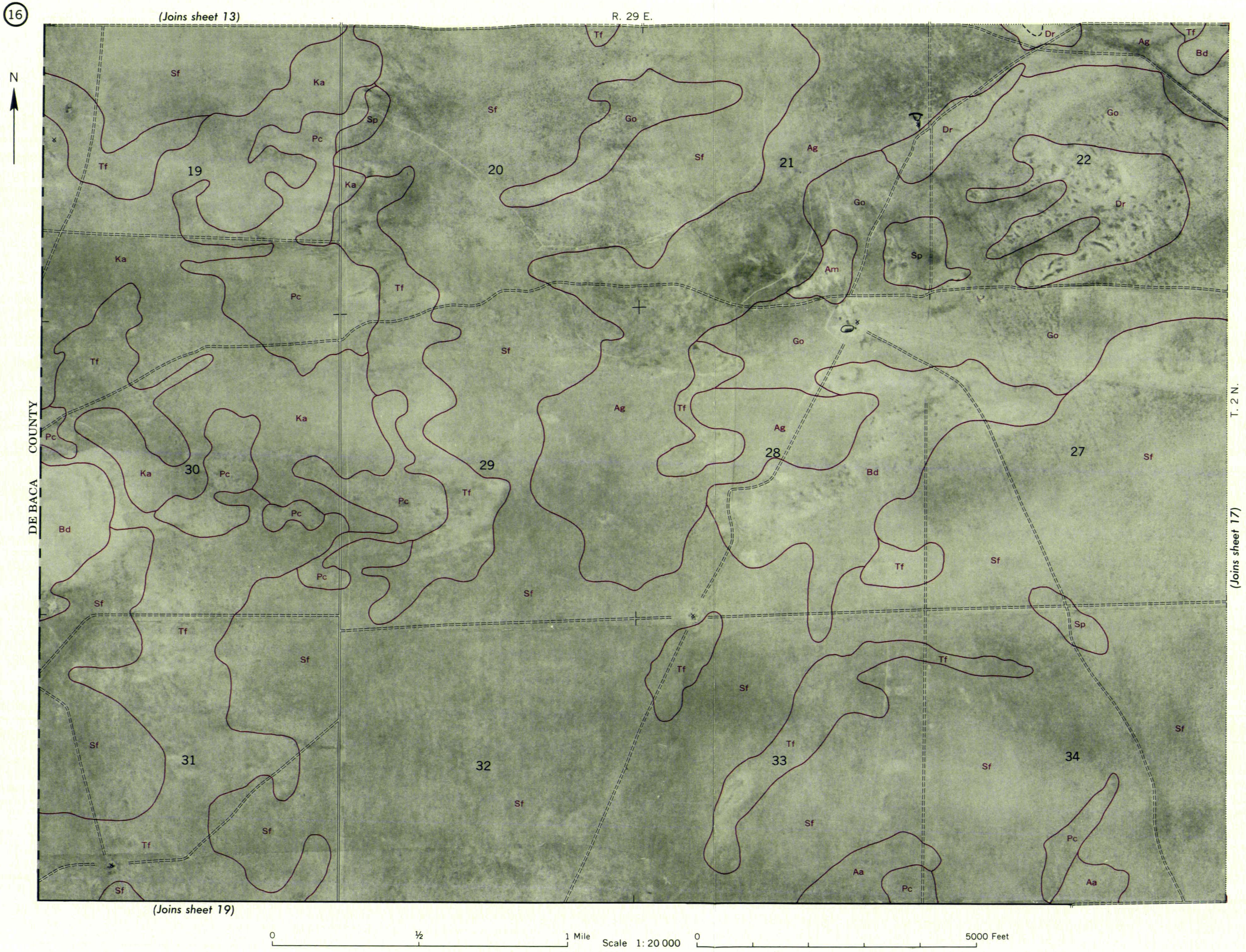
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

16


(Joins sheet 13)
R. 29 E.
N
DE BACA COUNTY
T. 2 N.
(Joins sheet 17)
(Joins sheet 19)
19
20
21
22
27
28
29
30
31
32
33
34
Sf
Ka
Sp
Pc
Tf
Go
Ag
Dr
Bd
Am
Aa
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

N

(Joins sheet 149) | (Joins sheet 150)

R. 34 E. | R. 35 E.

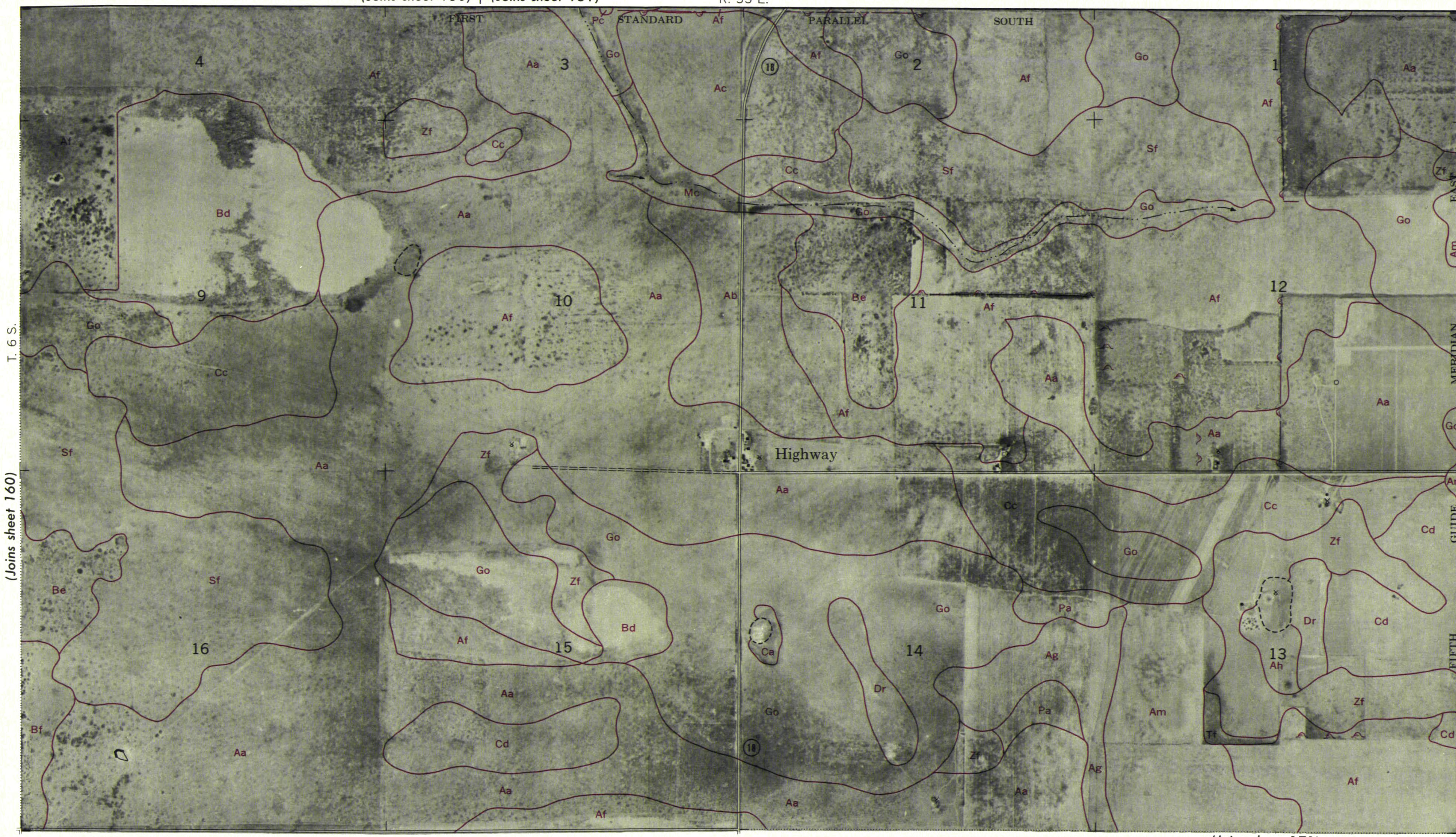
(Joins sheet 159)

T. 6 S.

(Joins sheet 161)

(Joins sheet 170)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

162

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

N

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


N
(Joins sheet 153)
(Joins sheet 154)
R. 37 E.
FIRST
STANDARD
PARALLEL
SOUTH
T. 6 S.
(Joins sheet 163)
(Joins sheet 165)
(Joins sheet 174)
Lingo
116
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

N

(Joins sheet 154) | (Joins sheet 155) R. 38 E.

T. 6 S.

(Joins sheet 164)

TEXAS

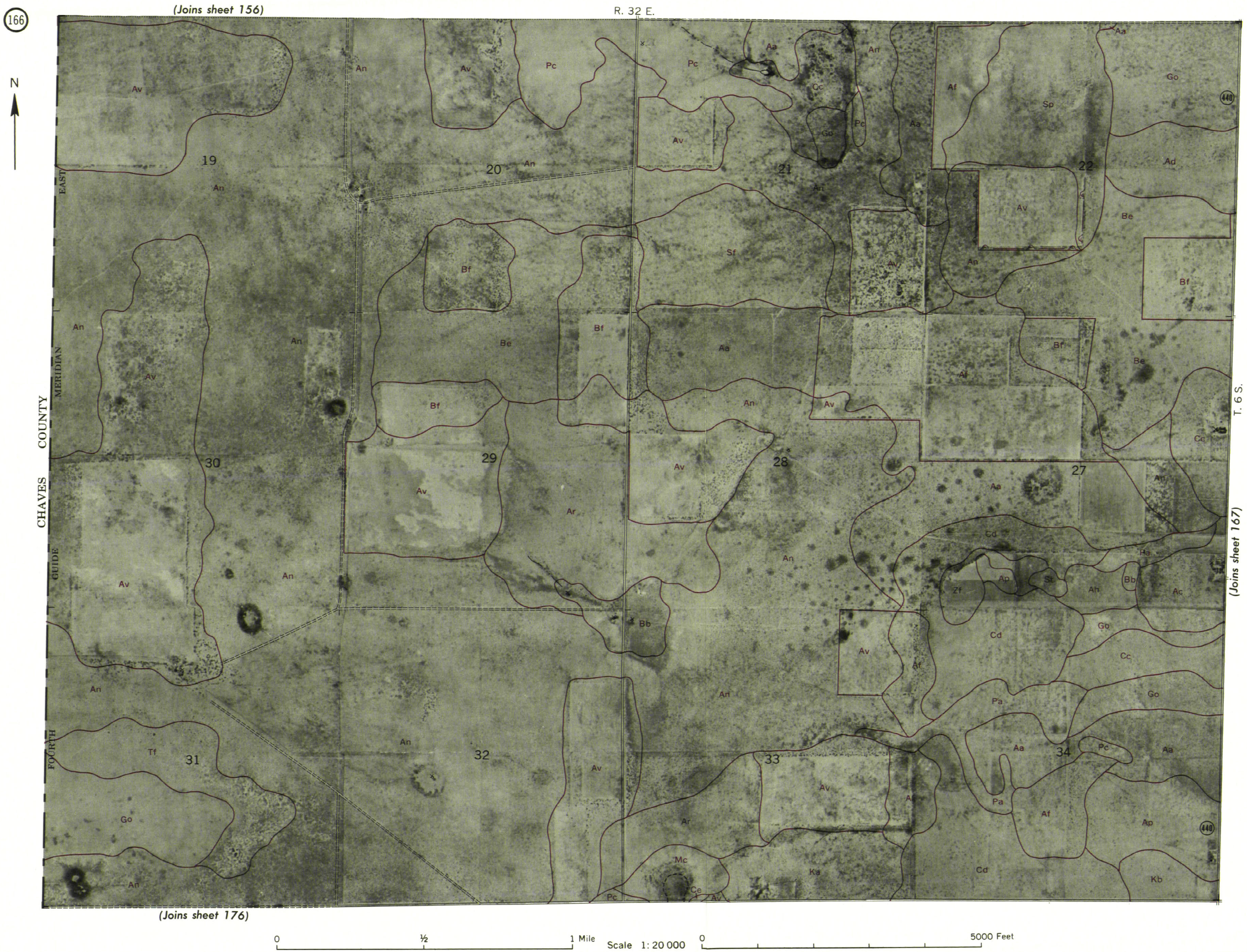
COCHRAN COUNTY

(Joins sheet 175)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite


166
(Joins sheet 156)
R. 32 E.
N
T. 6 S.
(Joins sheet 167)
(Joins sheet 176)
EAST
CHAVES COUNTY MERIDIAN
GUIDE
FOURTH
19
20
21
22
30
29
28
27
31
32
33
34
440
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

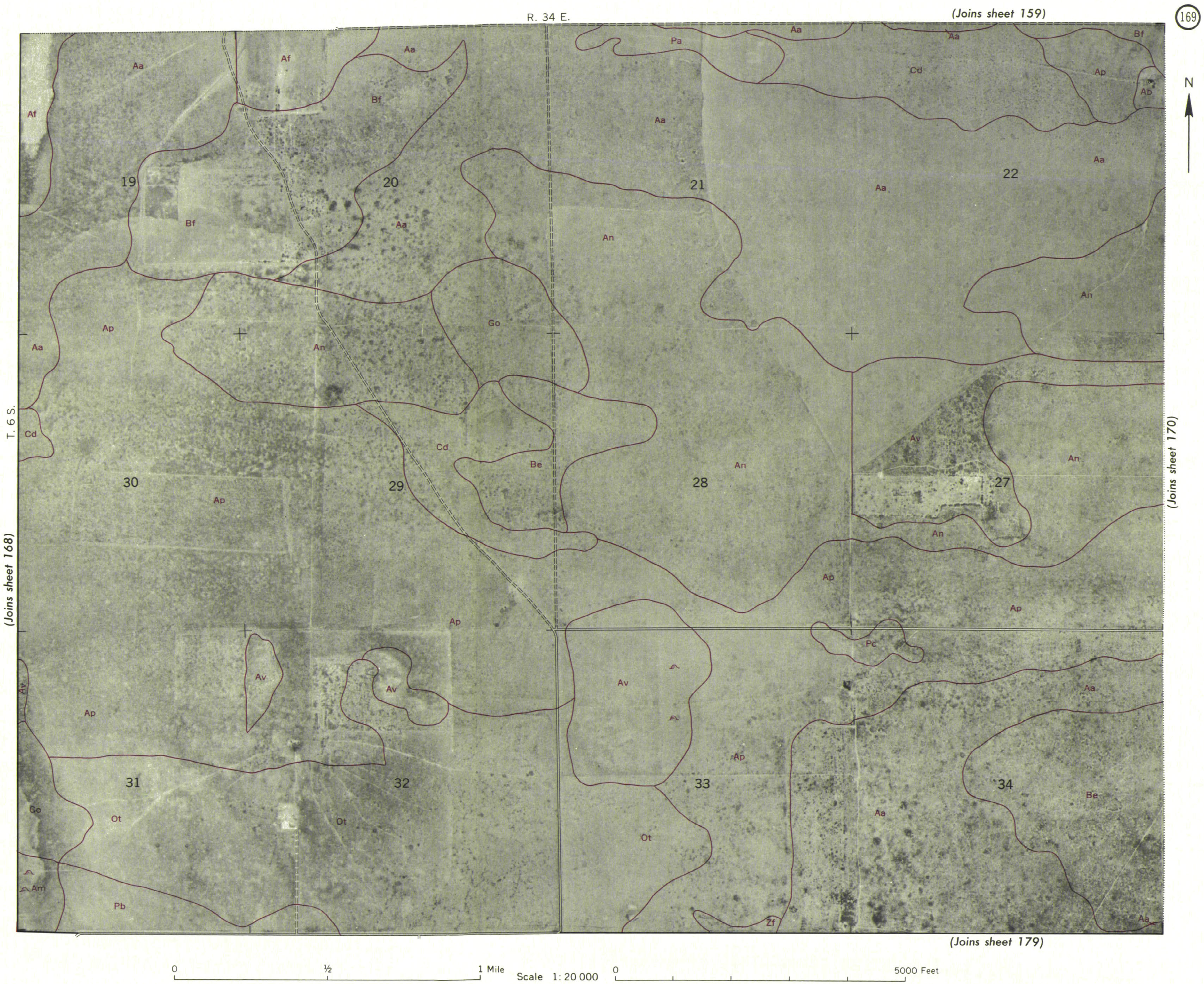
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


168
(Joins sheet 158)
R. 33 E.
N
(Joins sheet 167)
(Joins sheet 169)
(Joins sheet 178)
T. 6 S.
21
22
23
24
28
27
26
25
33
34
35
36
Aa
Af
Bd
An
Ag
Be
Av
Bf
Cd
Ap
Go
Am
Ka
Ab
Su
Ar
Cf
0
½
1 Mile
Scale 1: 20 000
5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

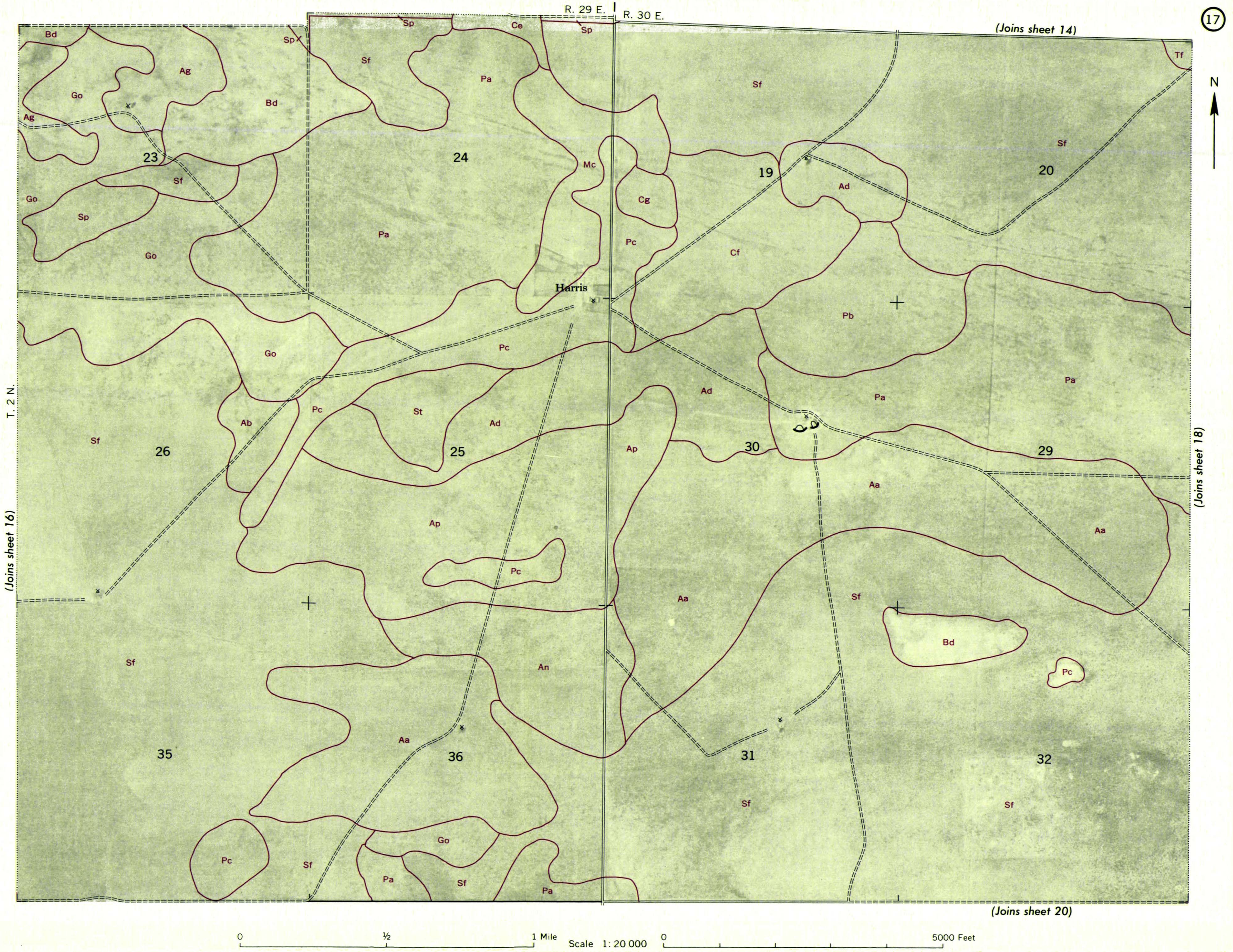
Range, township, and section corners shown on this map are indefinite.



ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 17

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



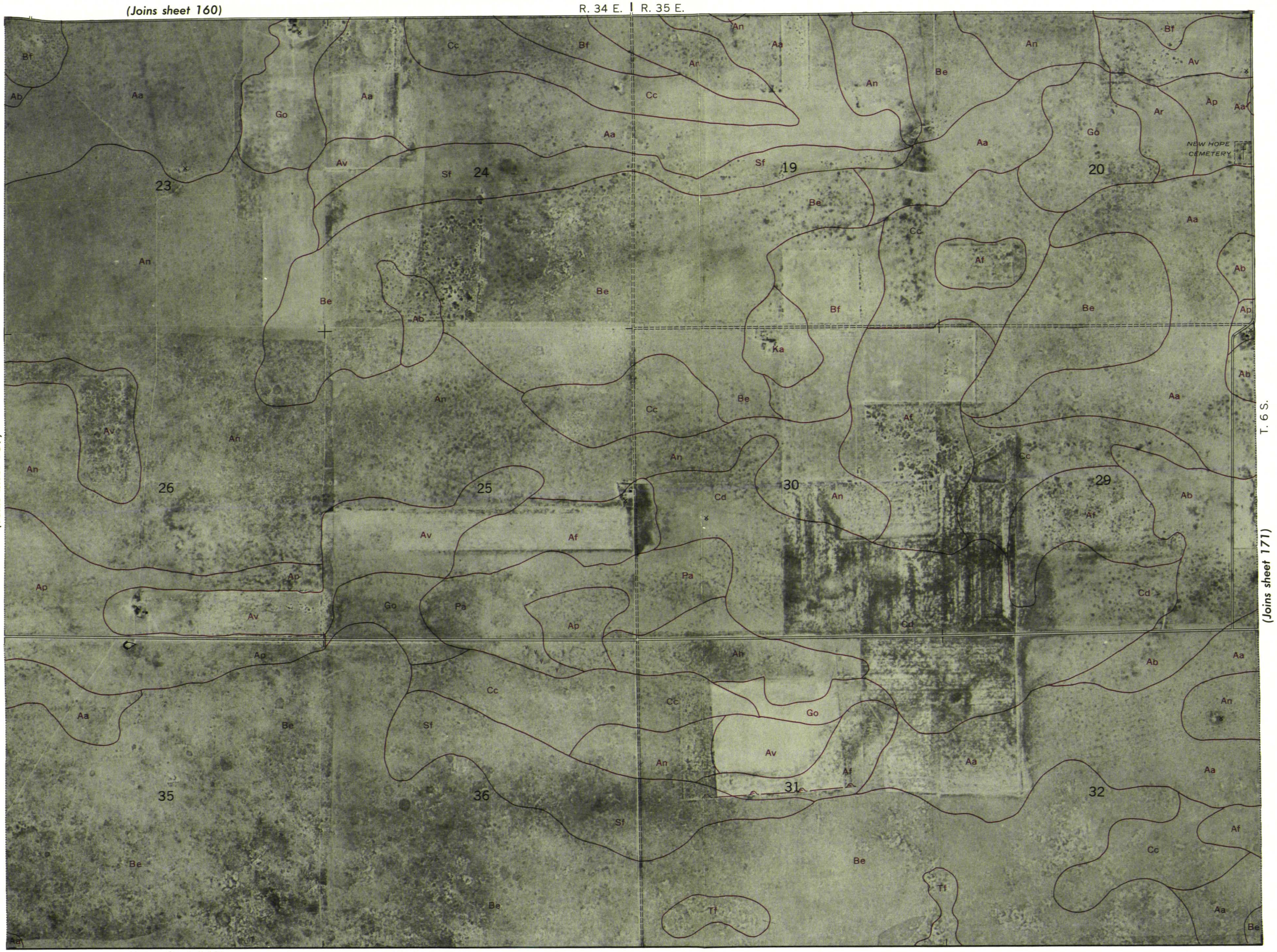
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 170

170

(Joins sheet 160)

R. 34 E. | R. 35 E.

N



(Joins sheet 169)

T. 6 S.

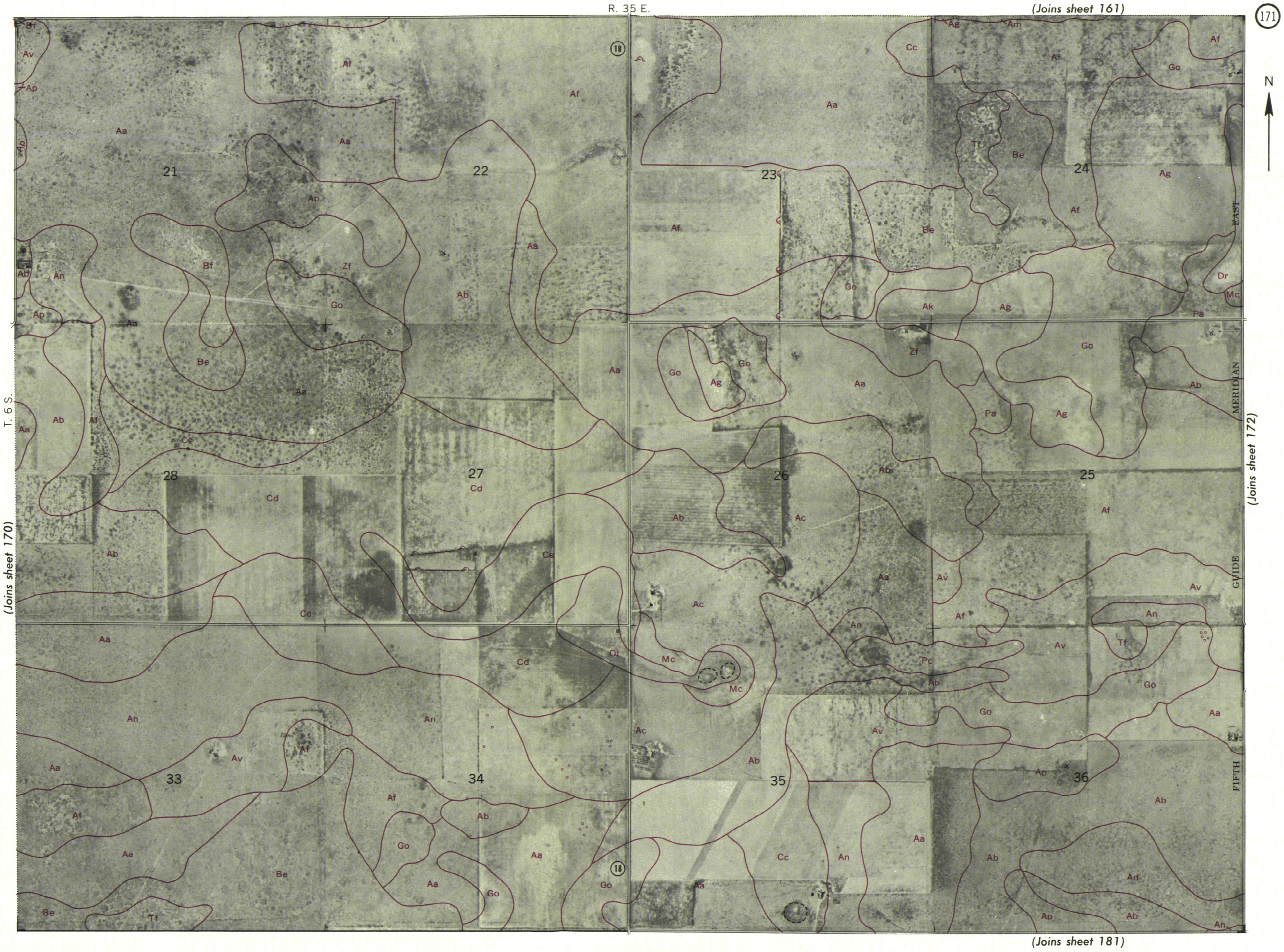
(Joins sheet 171)

(Joins sheet 180)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(172)

(Joins sheet 162)

R. 36 E.

N

T. 6 S.

(Joins sheet 171)

(Joins sheet 173)

(Joins sheet 182)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

R. 36 E. | R. 37 E.

(Joins sheet 163)

173

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

T. 6 S.

(Joins sheet 172)

(Joins sheet 174)

(Joins sheet 183)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

174

(Joins sheet 164)

R. 37 E.

(Joins sheet 173)

(Joins sheet 175)

(Joins sheet 184)

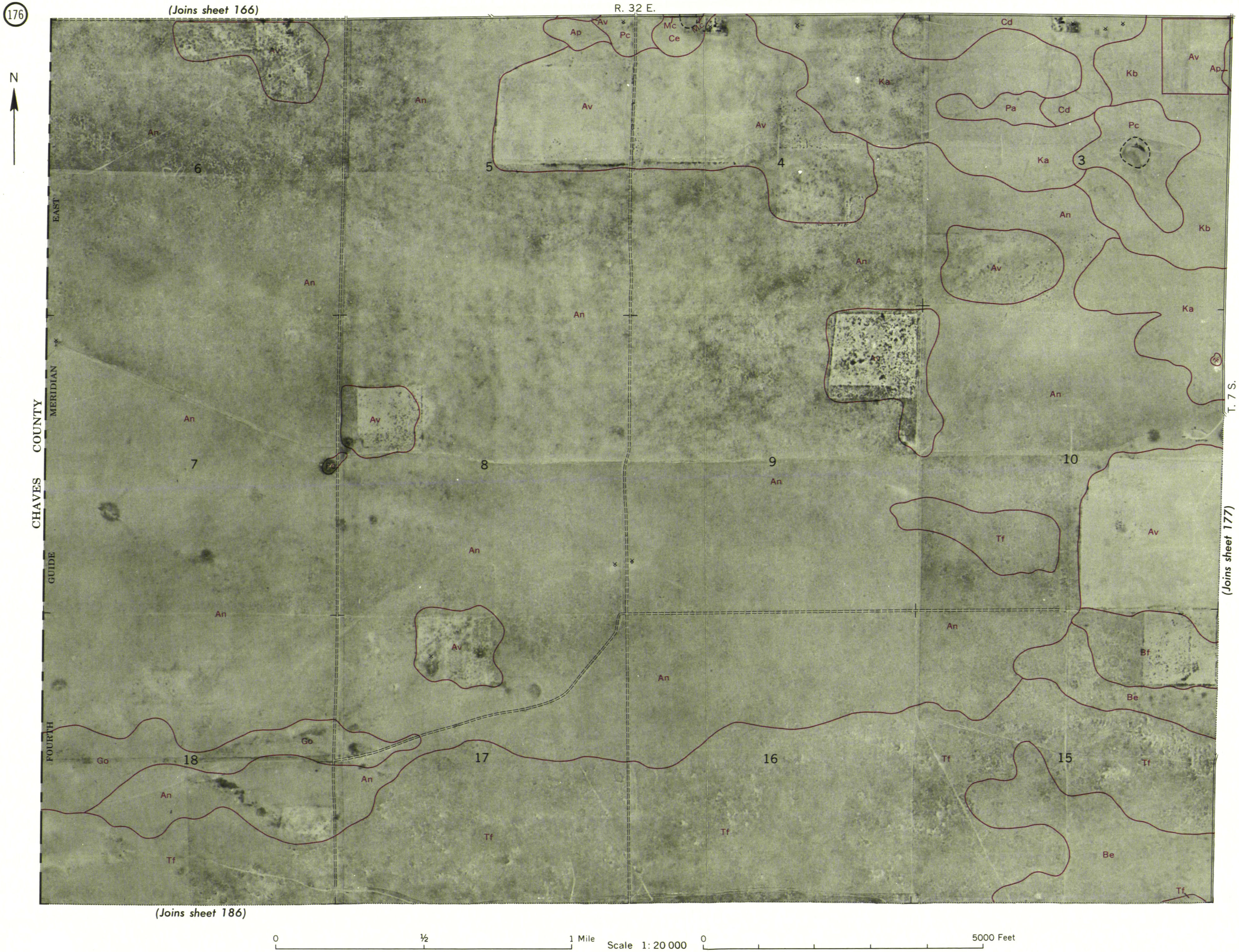
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

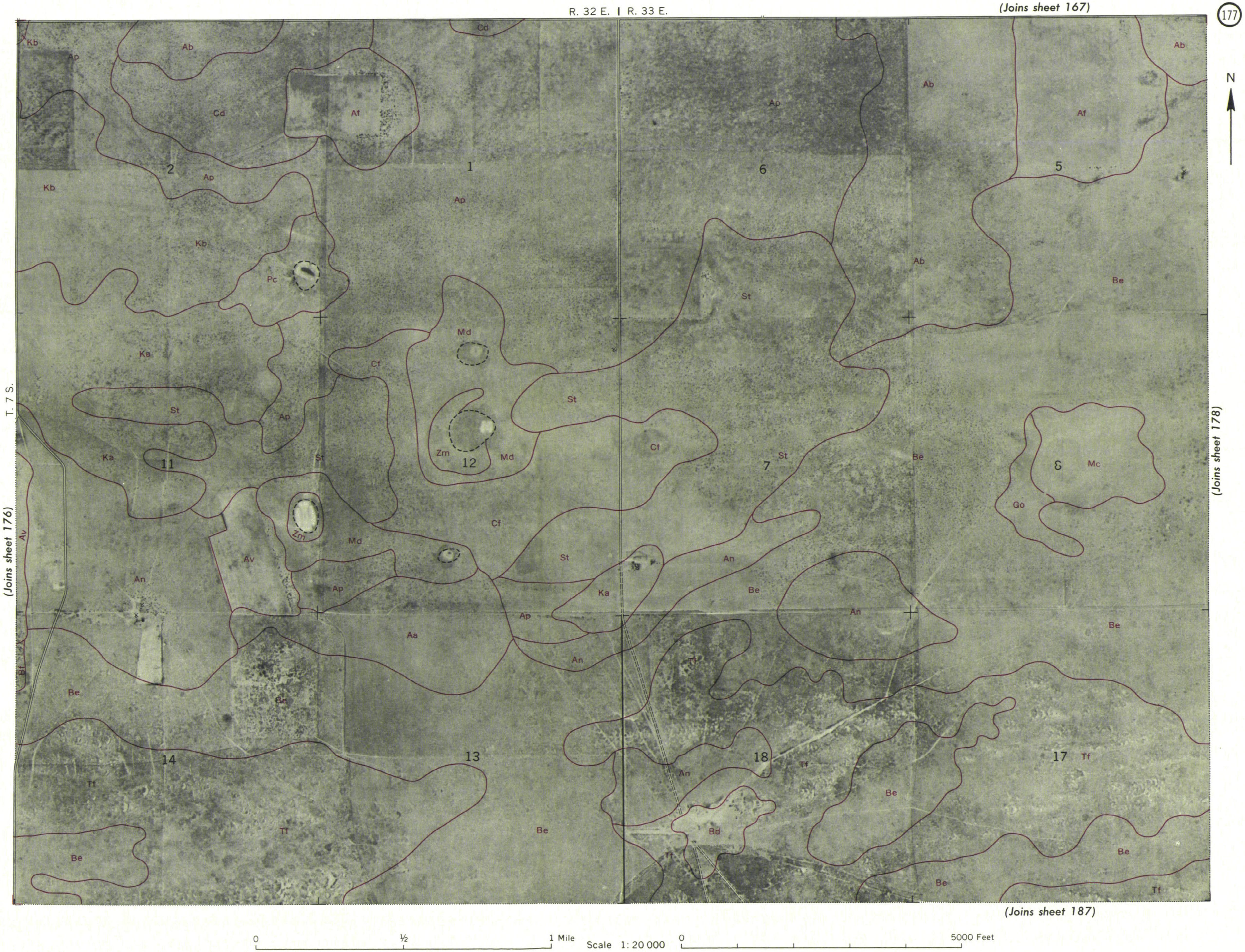
N

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

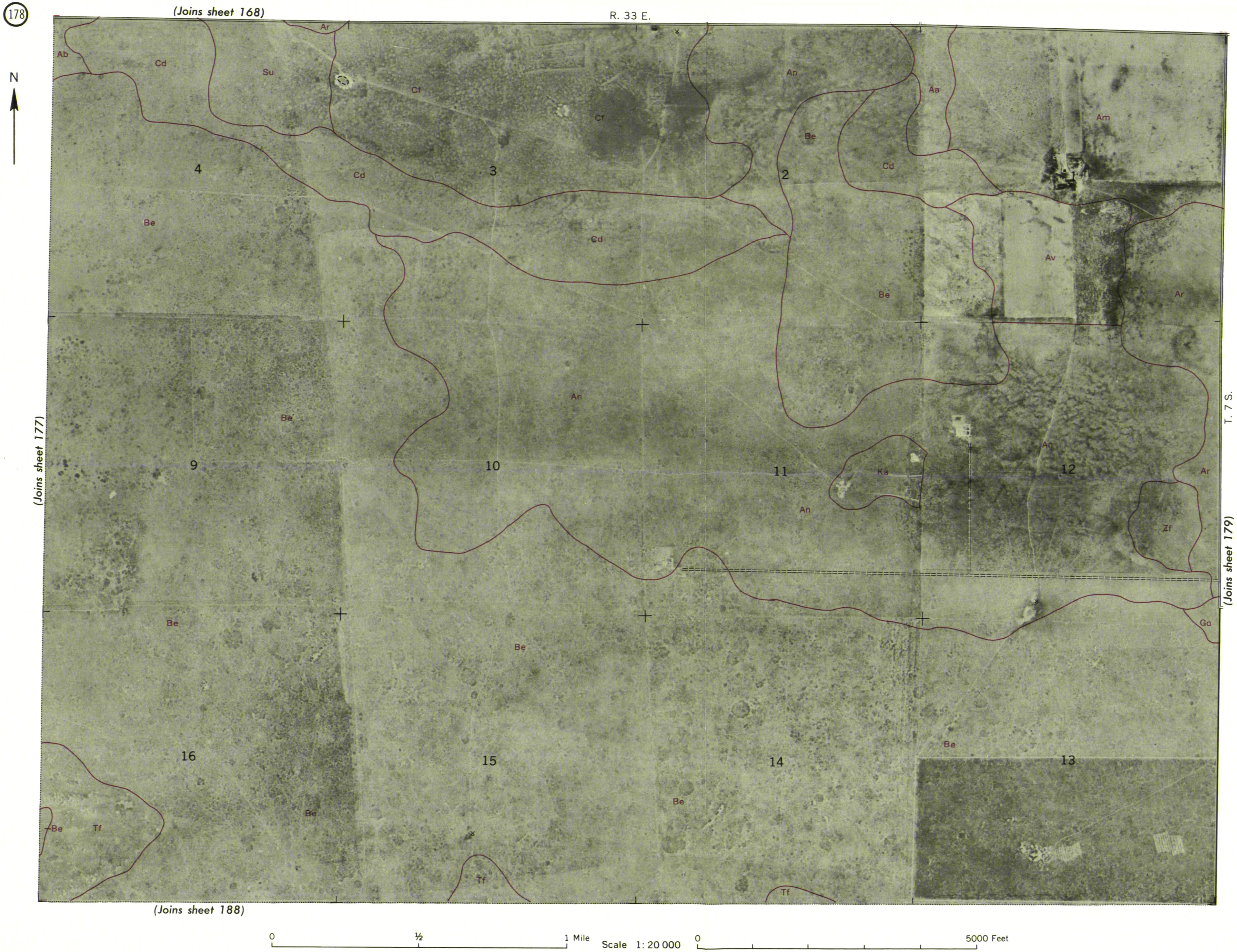

176
(Joins sheet 166)
R. 32 E.
N
FOURTH GUIDE MERIDIAN EAST
CHAVES COUNTY
T. 7 S.
(Joins sheet 177)
(Joins sheet 186)
6
5
4
3
7
8
9
10
18
17
16
15
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



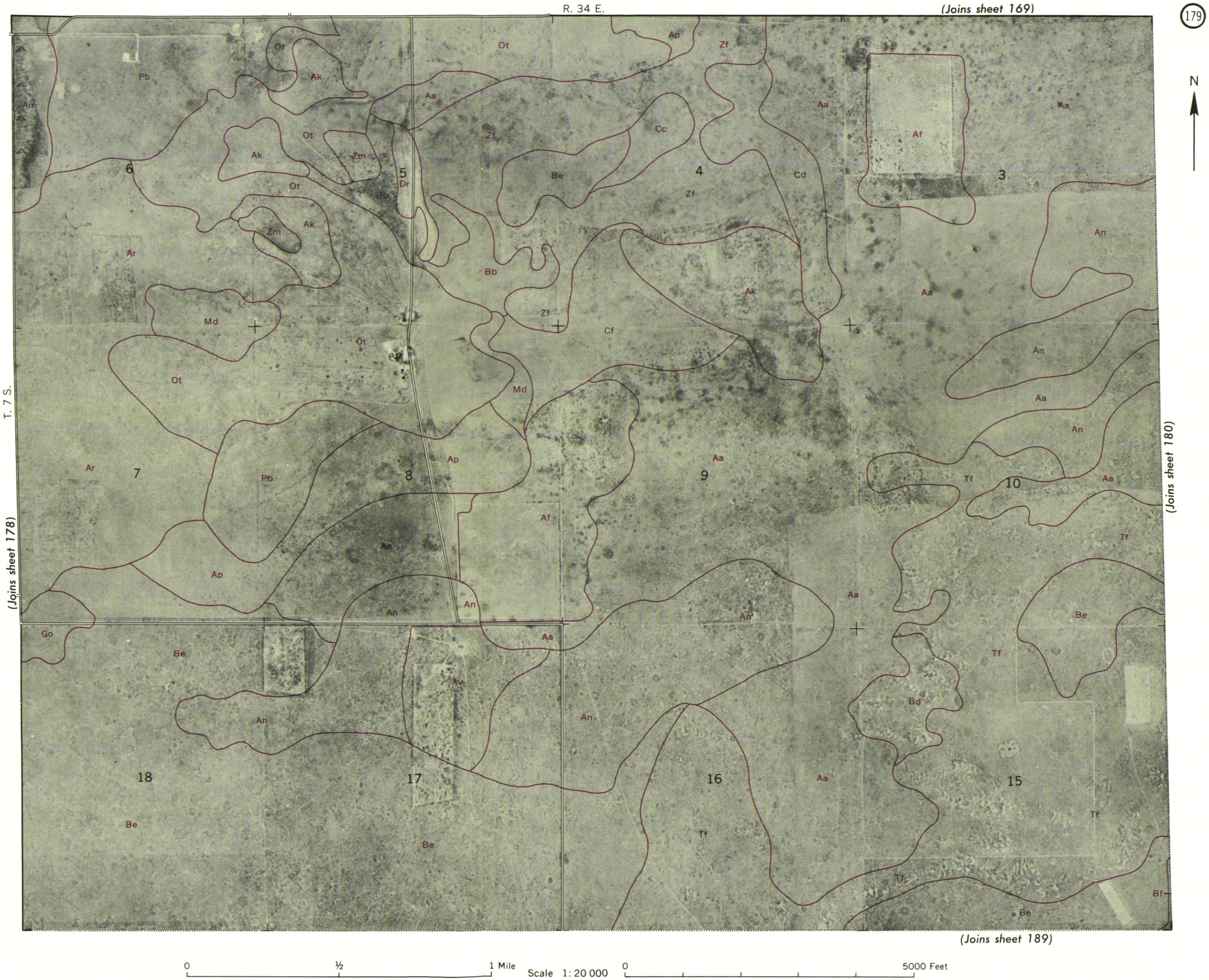
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 178



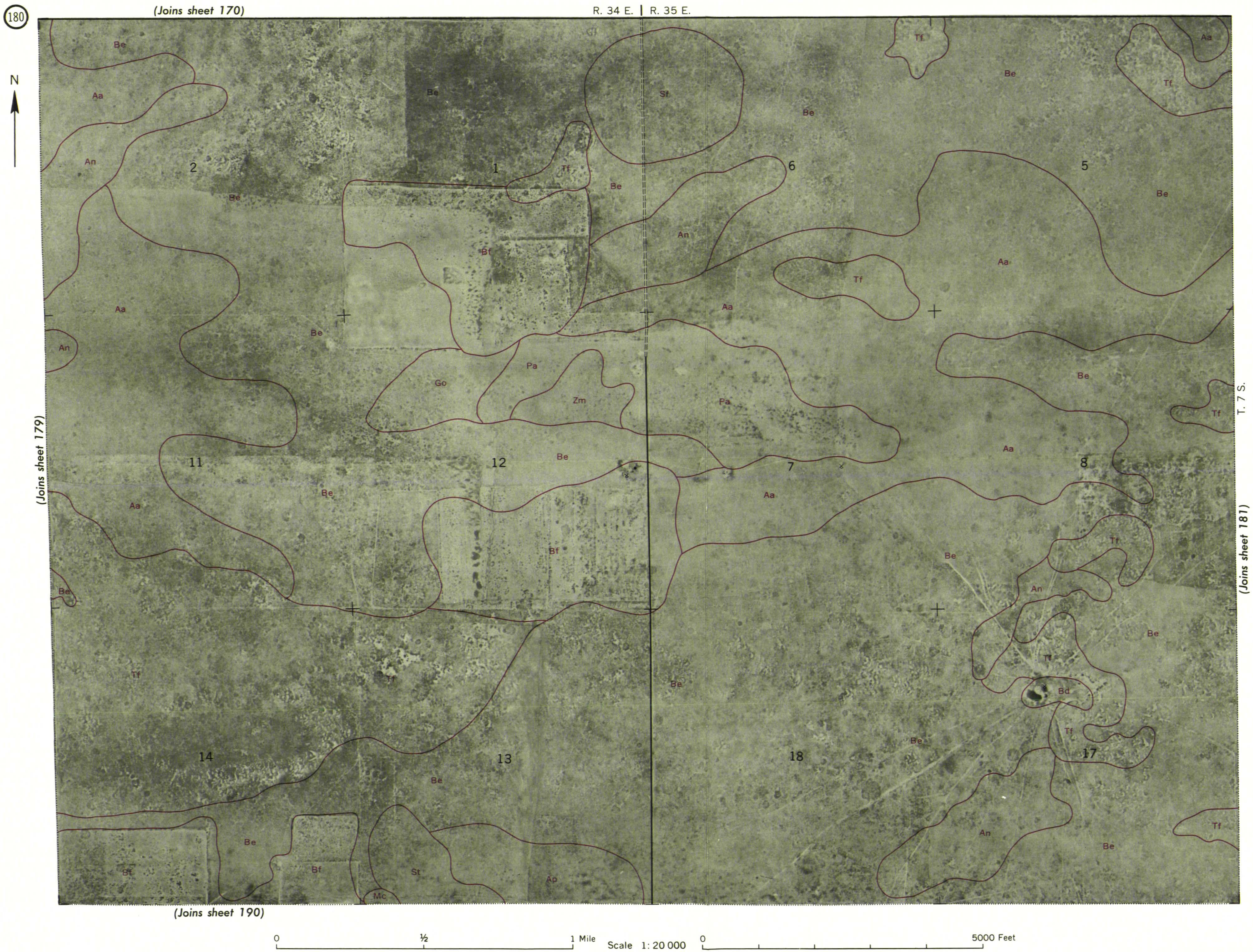
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 179



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


180
(Joins sheet 170)
R. 34 E. | R. 35 E.
N
(Joins sheet 179)
(Joins sheet 181)
T. 7 S.
(Joins sheet 190)
1
2
5
6
7
8
11
12
13
14
17
18
Be
Aa
An
Tf
Sf
Bf
Pa
Go
Zm
Bd
Bt
St
Ap
Mc
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

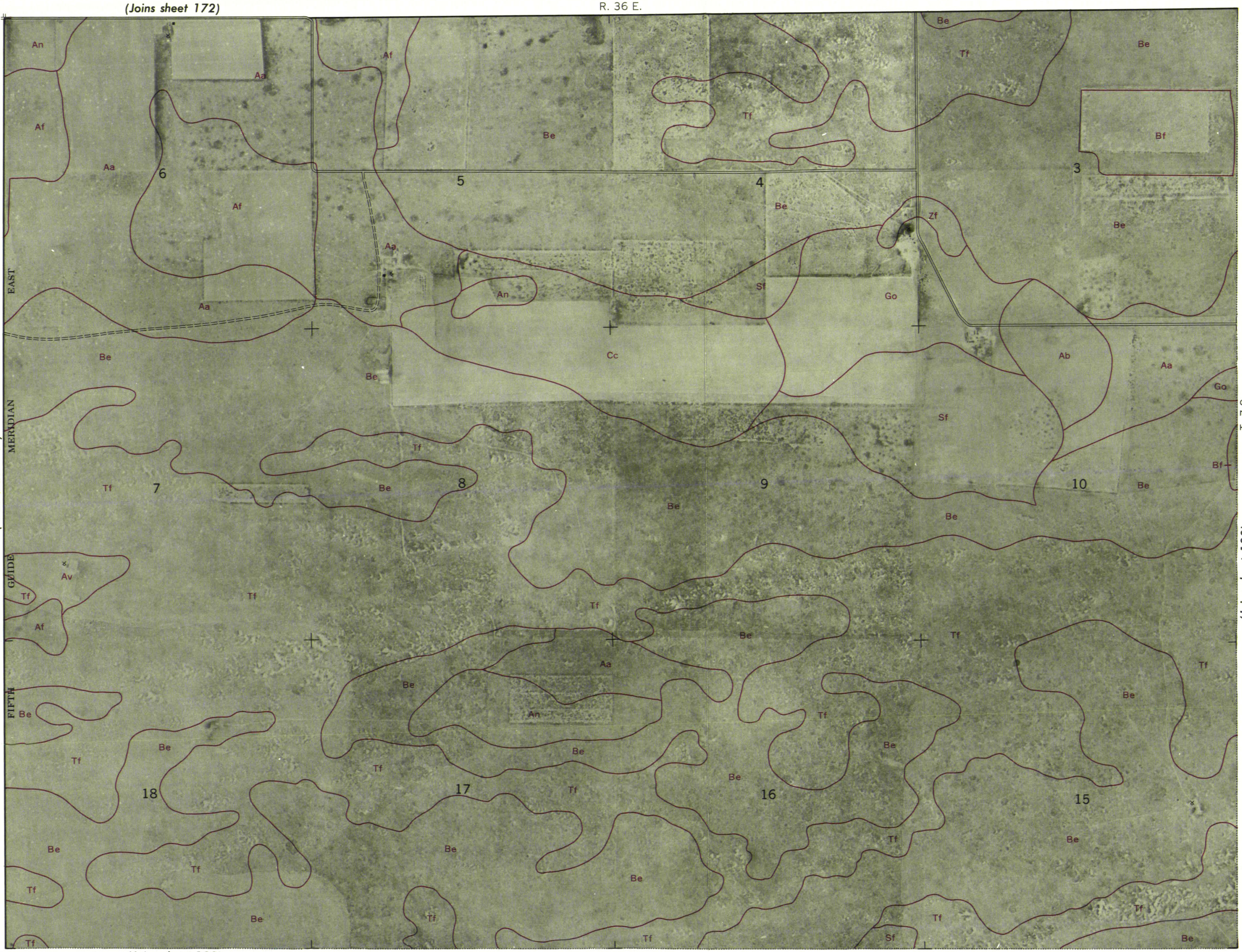
Scale 1: 20 000

0 5000 Feet

182

(Joins sheet 172)

(Joins sheet 181)



(Joins sheet 183)

(Joins sheet 192)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

R. 36 E. | R. 37 E.

(Joins sheet 173)

183

(Joins sheet 193)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

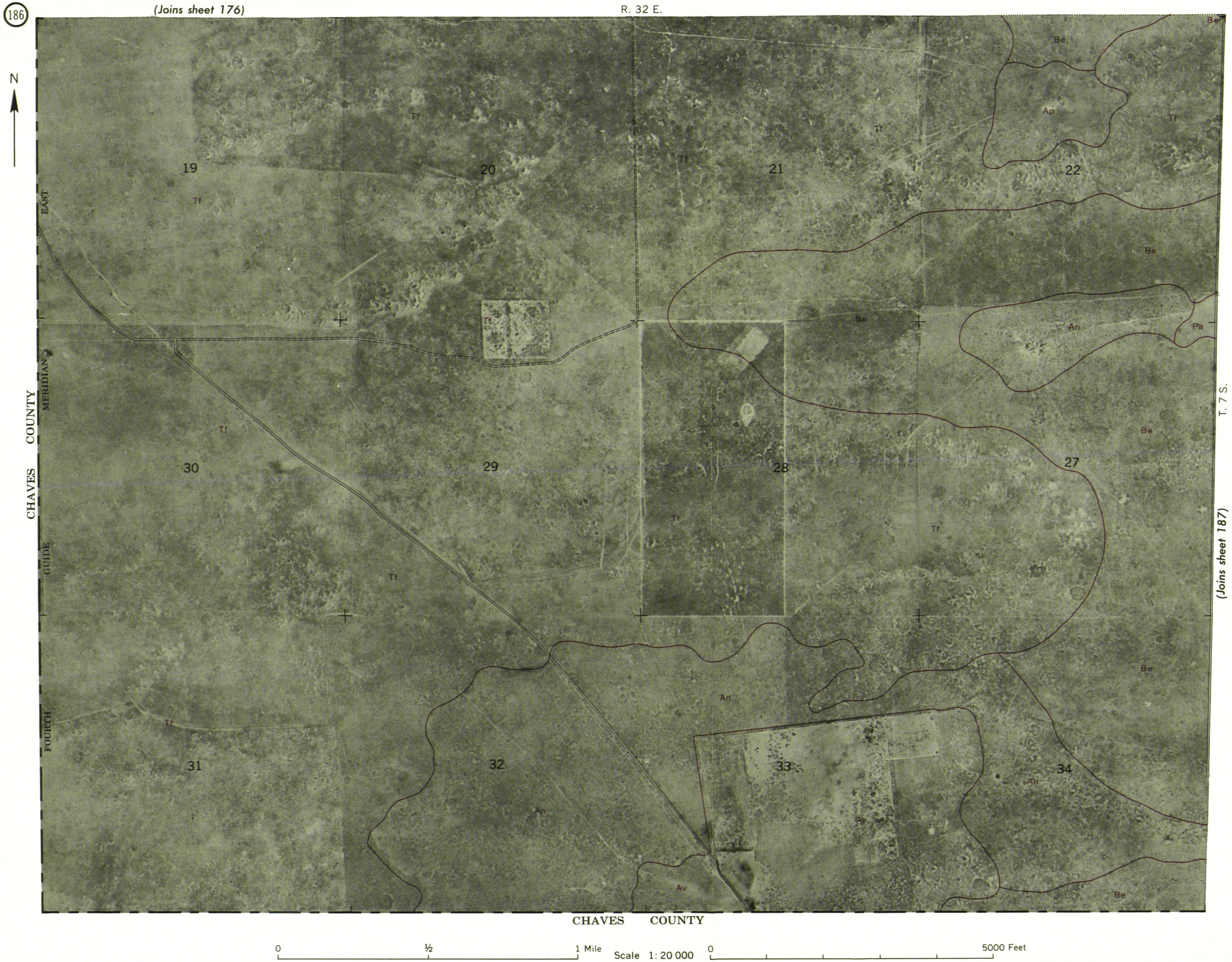
Scale 1: 20 000

0 ½ 1 Mile

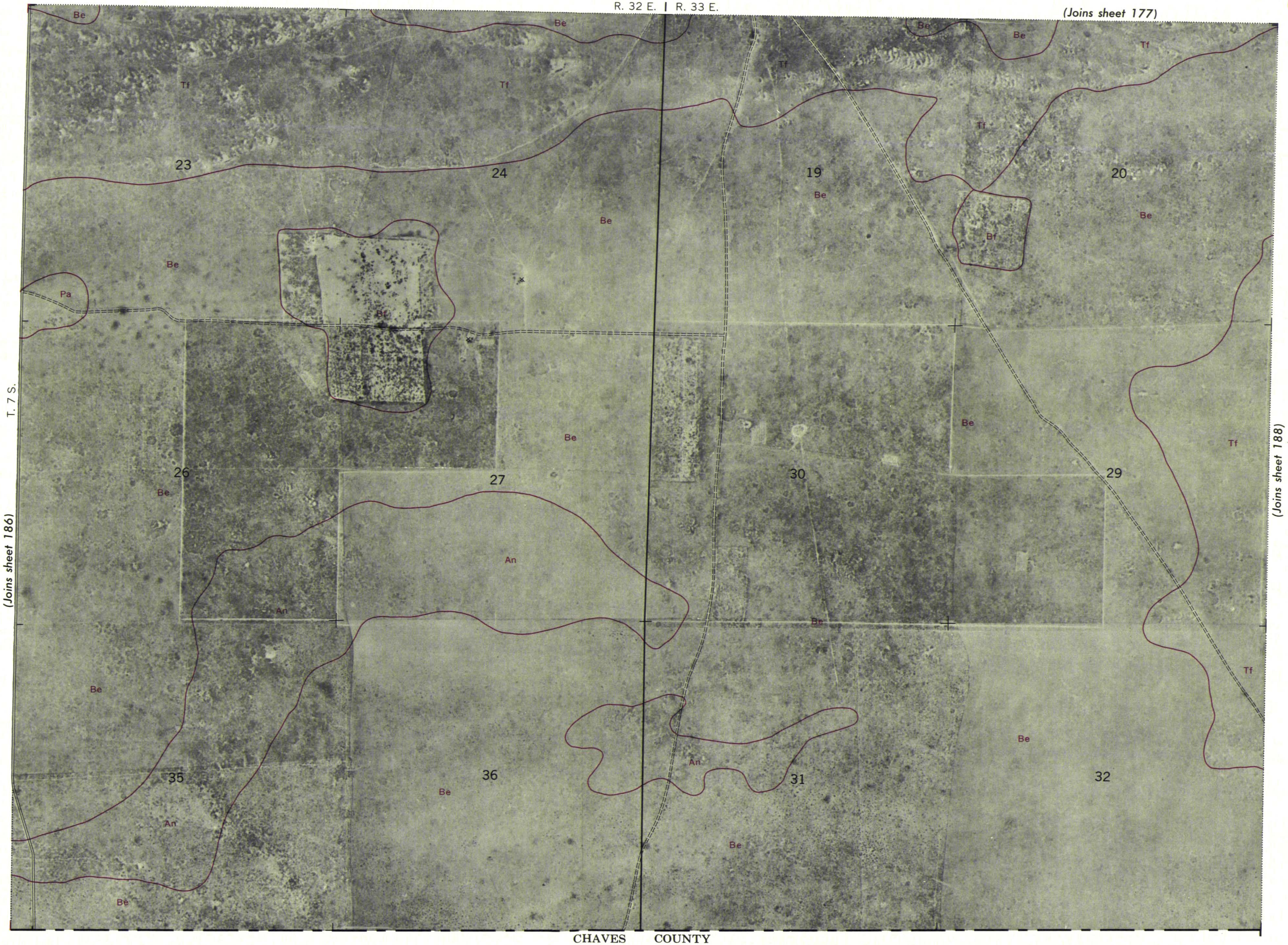
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station

Range, township, and section corners shown on this map are indefinite.


186
(Joins sheet 176)
R. 32 E.
N
EAST
MERIDIAN
GUIDE
FOURTH
CHAVES COUNTY
T. 7 S.
(Joins sheet 187)
CHAVES COUNTY
19
20
21
22
30
29
28
27
31
32
33
34
Tf
Be
Ap
An
Pa
Av
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

187



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 188

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

R. 34 E.

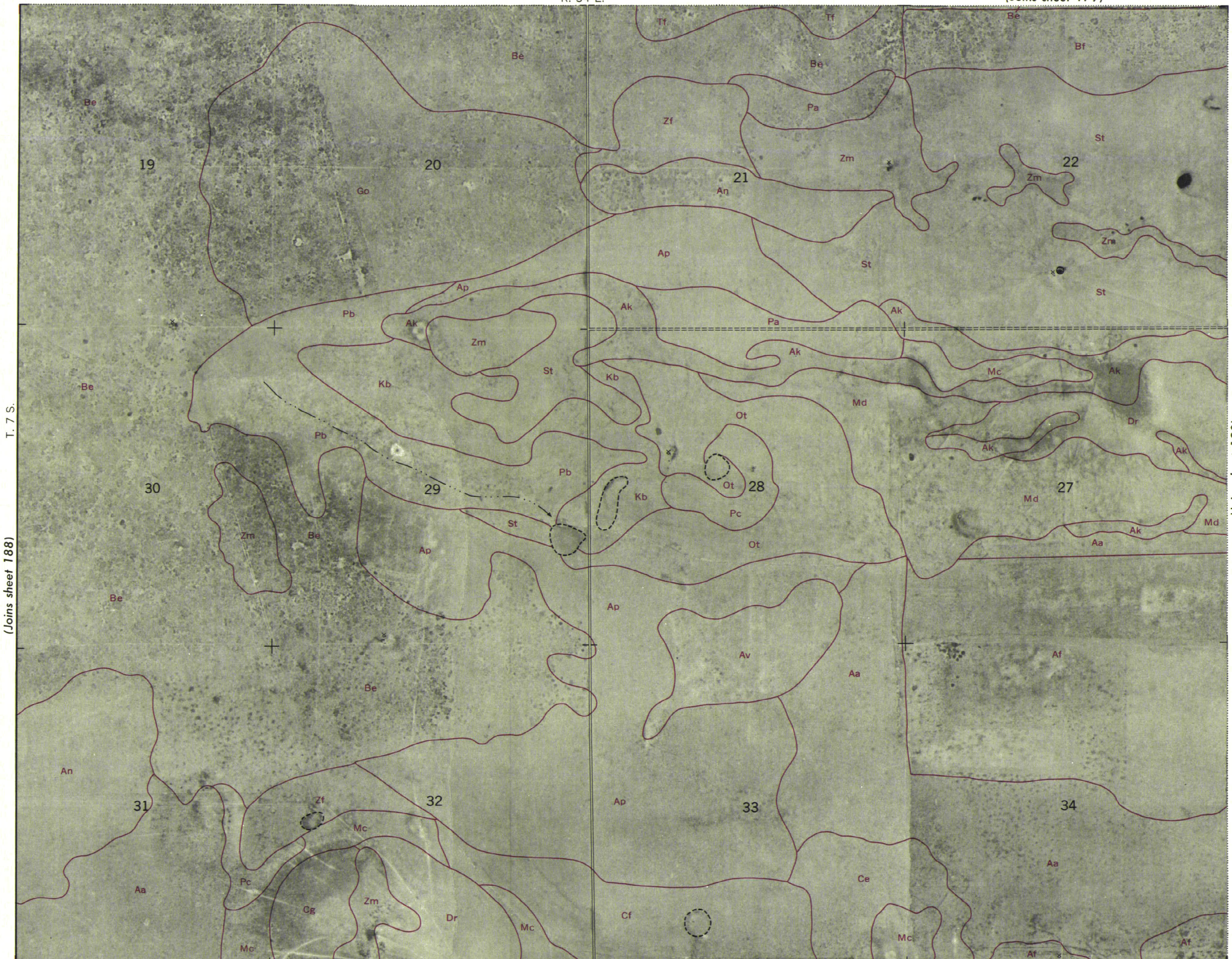
(Joins sheet 179)

189

T. 7 S.

(Joins sheet 188)

(Joins sheet 190)

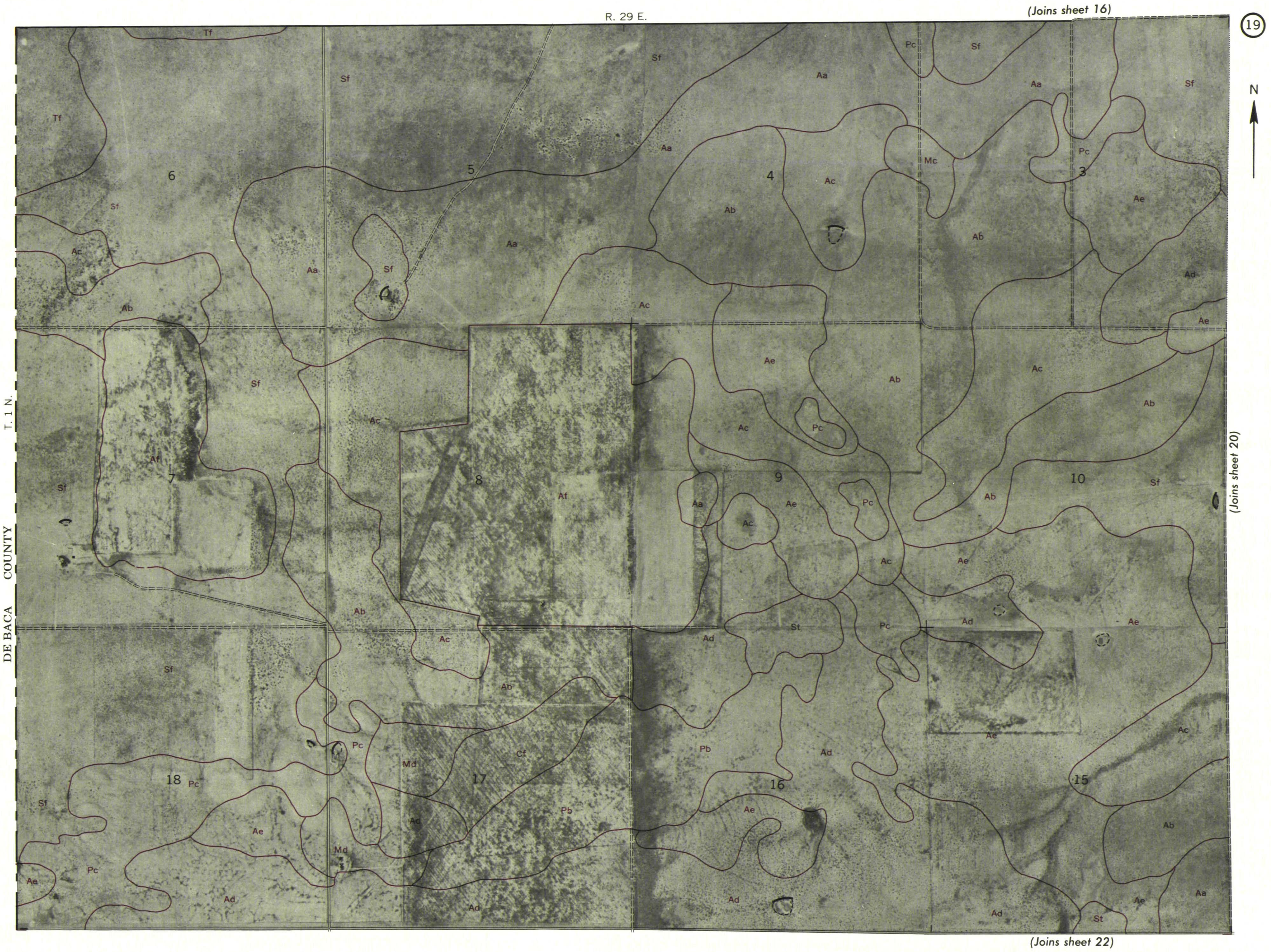


(Joins sheet 196)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

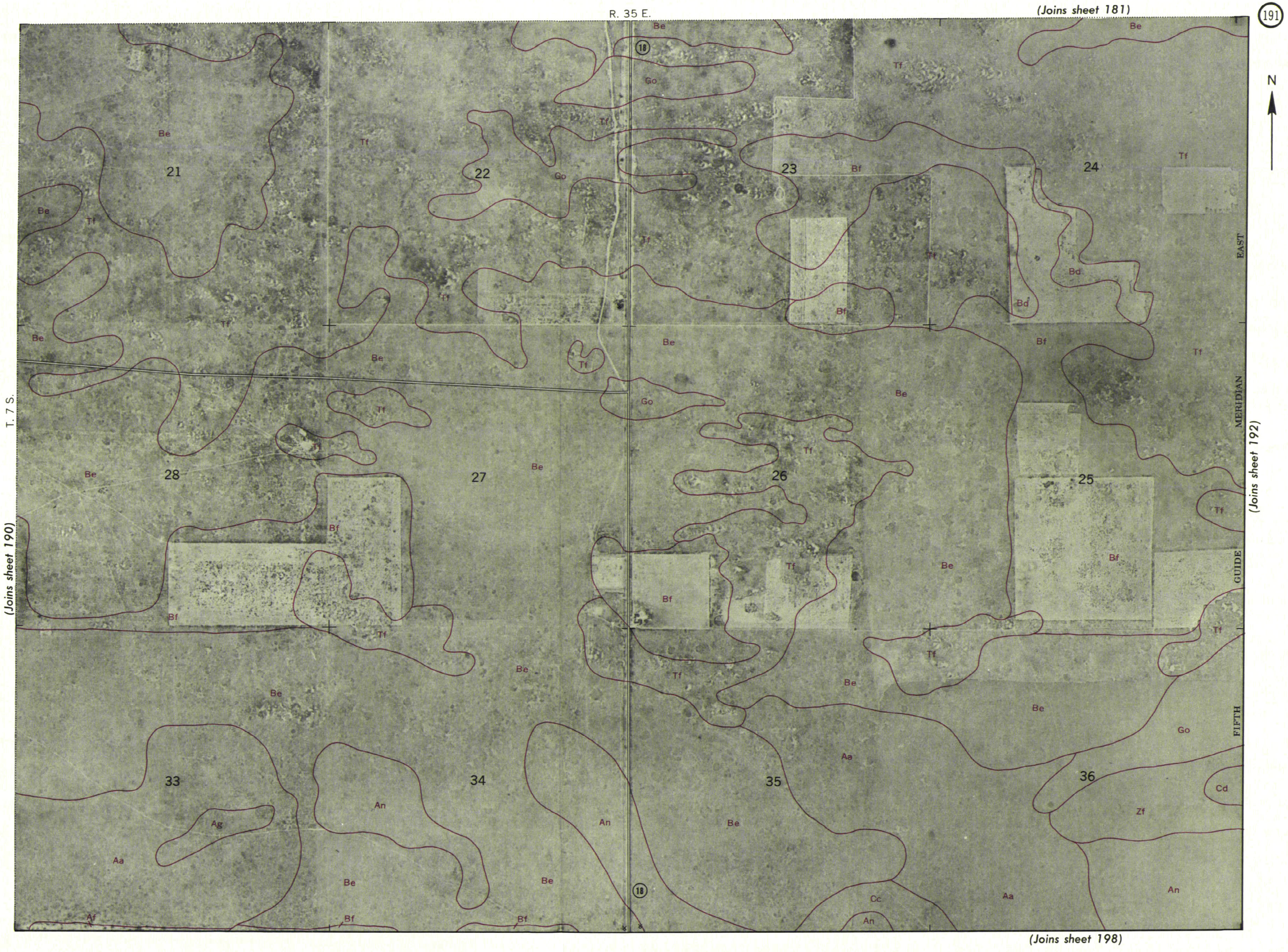


This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


190
(Joins sheet 180)
R. 34 E. | R. 35 E.
N
(Joins sheet 189)
(Joins sheet 191)
T. 7 S.
(Joins sheet 197)
23
24
19
20
26
25
30
29
35
36
31
32
Bf
Mc
Dr
Ap
St
Ka
Av
Be
Tf
Zf
Zm
Ak
Md
Pa
Aa
Cd
Ah
Cc
Go
Af
Ab
Ag
0
½
1 Mile
Scale 1:20 000
5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station

Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 192

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 185)

R. 38 E.

(Joins sheet 194)

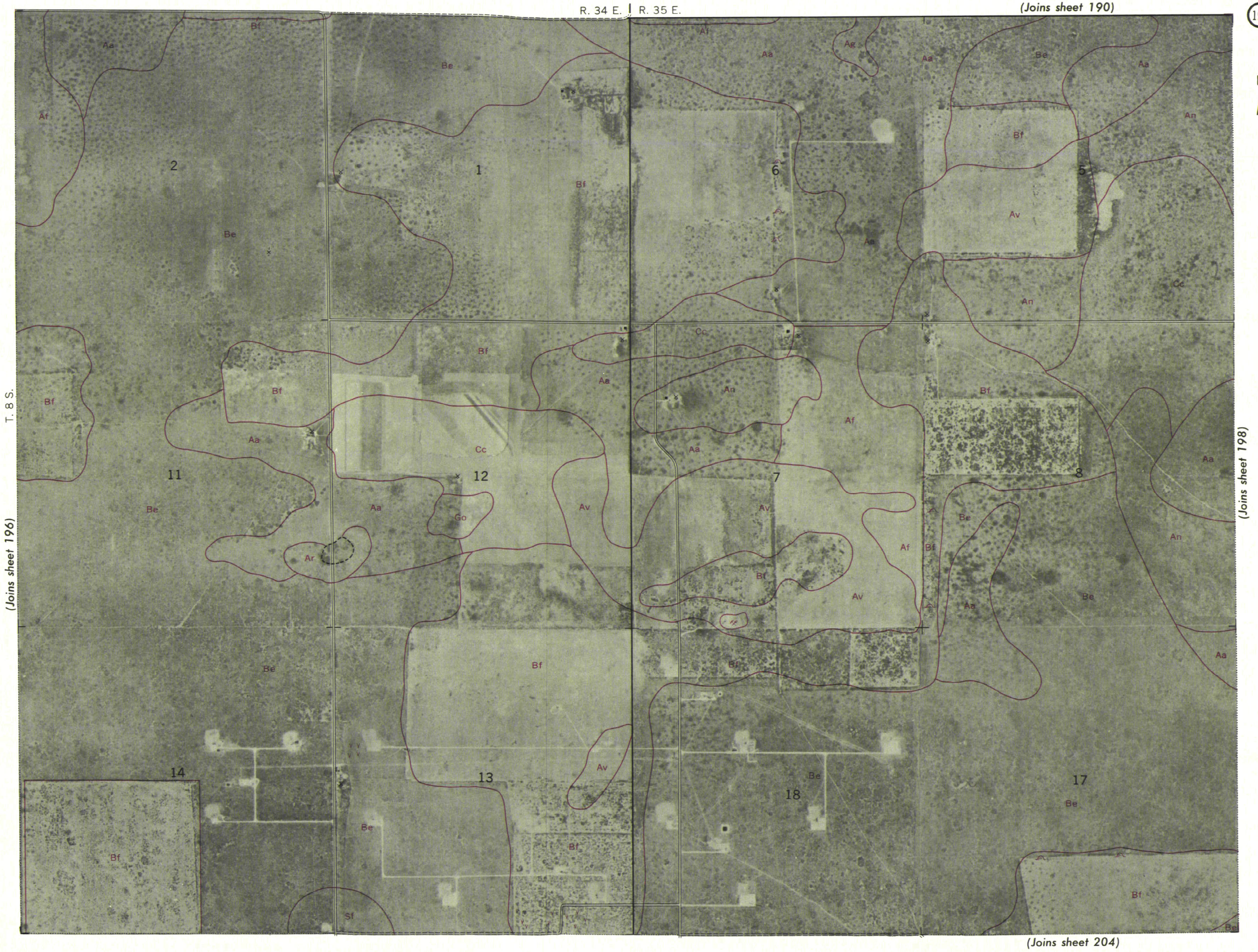
(Joins sheet 202)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite


196
(Joins sheet 189)
R. 34 E.
N
EAST
MERIDIAN
CHAVES COUNTY
GUIDE
FOURTH
T. 8 S.
(Joins sheet 197)
(Joins sheet 203)
6
5
4
3
7
8
9
10
18
17
16
15
Aa
Cg
Dr
Mc
Zm
Cf
Ap
Ce
Af
Av
Be
An
Cd
Bf
Ab
Pa
Go
Cc
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



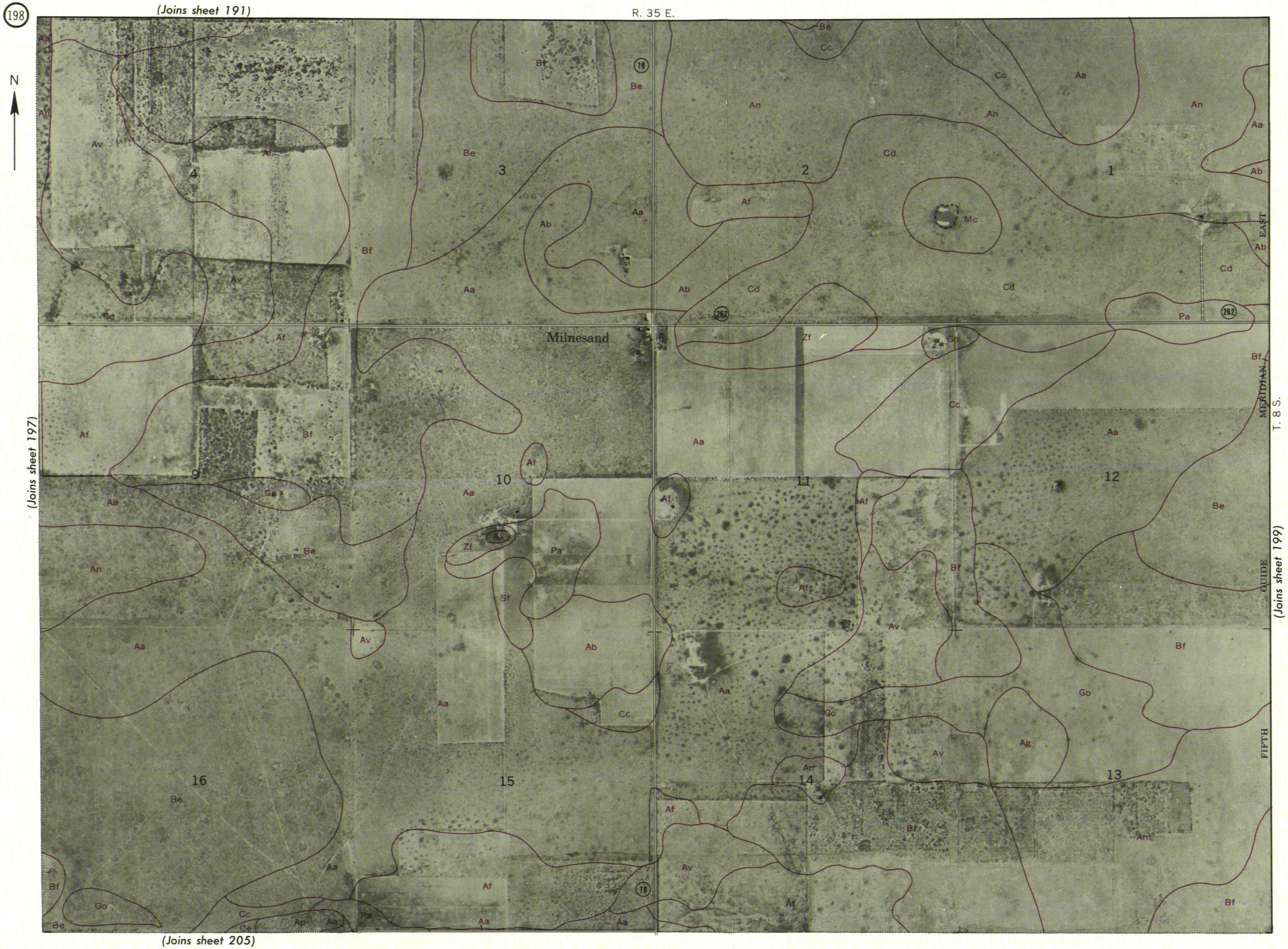
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 199

(199)

R. 36 E.

(Joins sheet 192)

N

T. 8 S.

(Joins sheet 198)

(Joins sheet 200)

(Joins sheet 206)

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

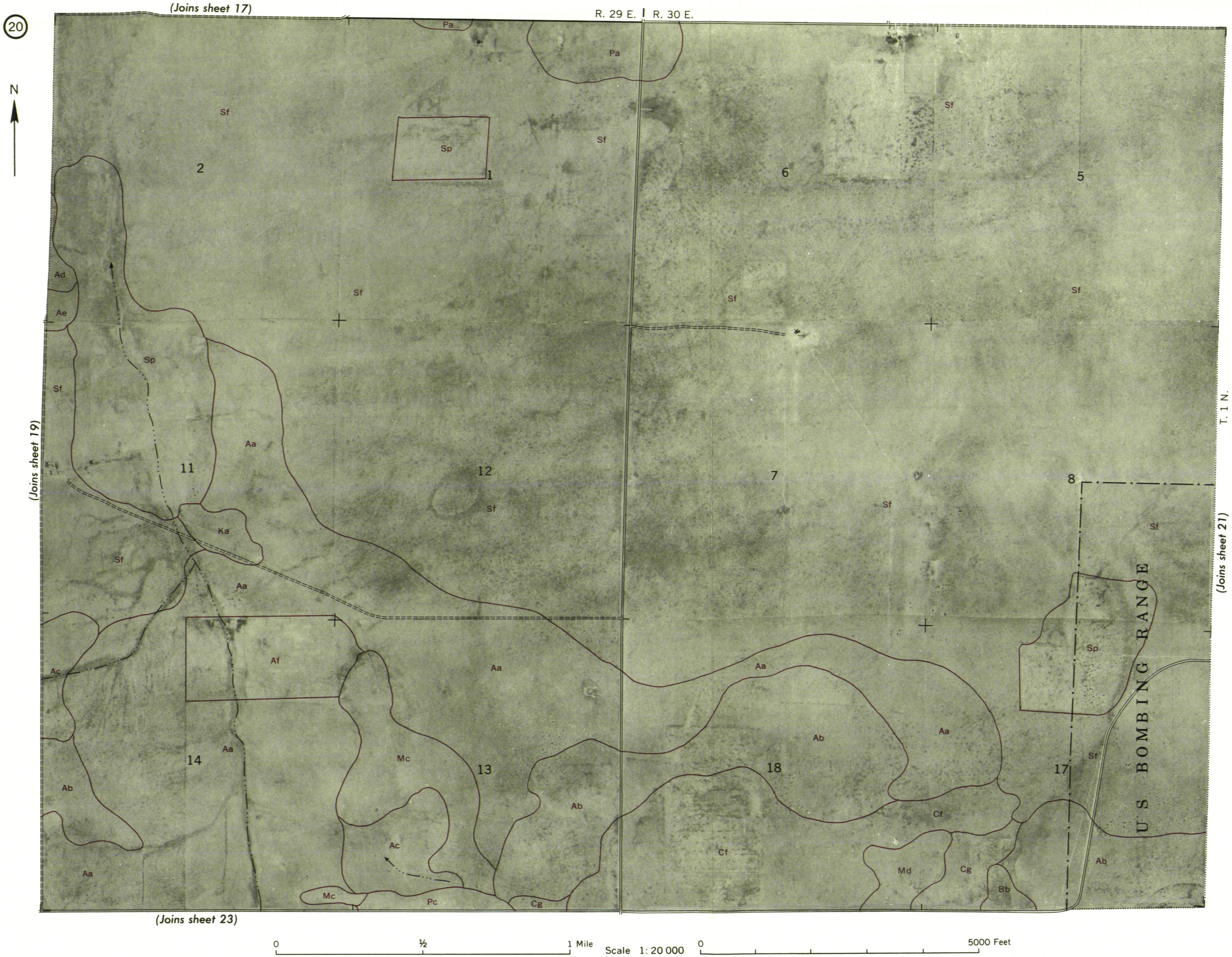
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

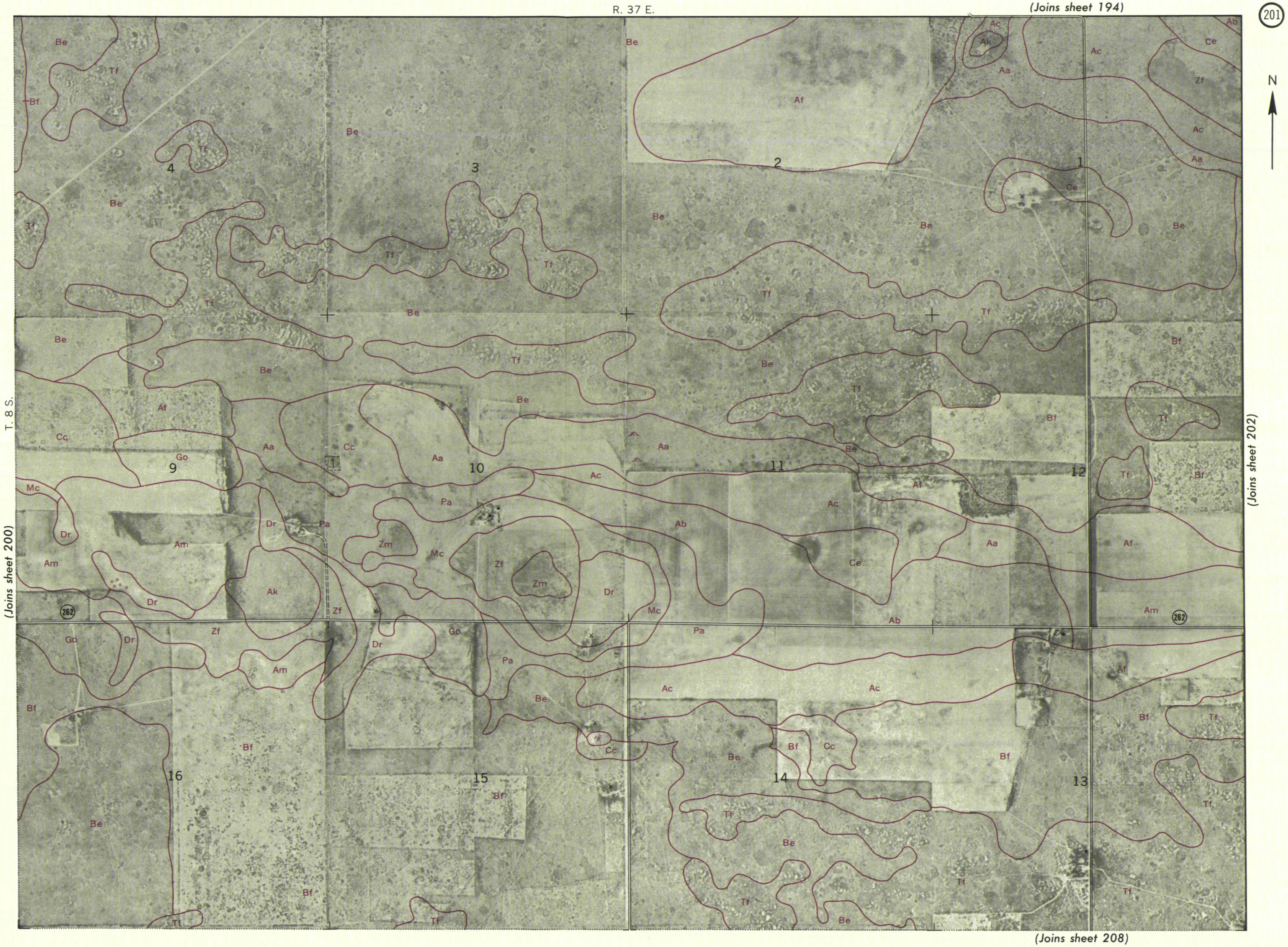
2

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 20



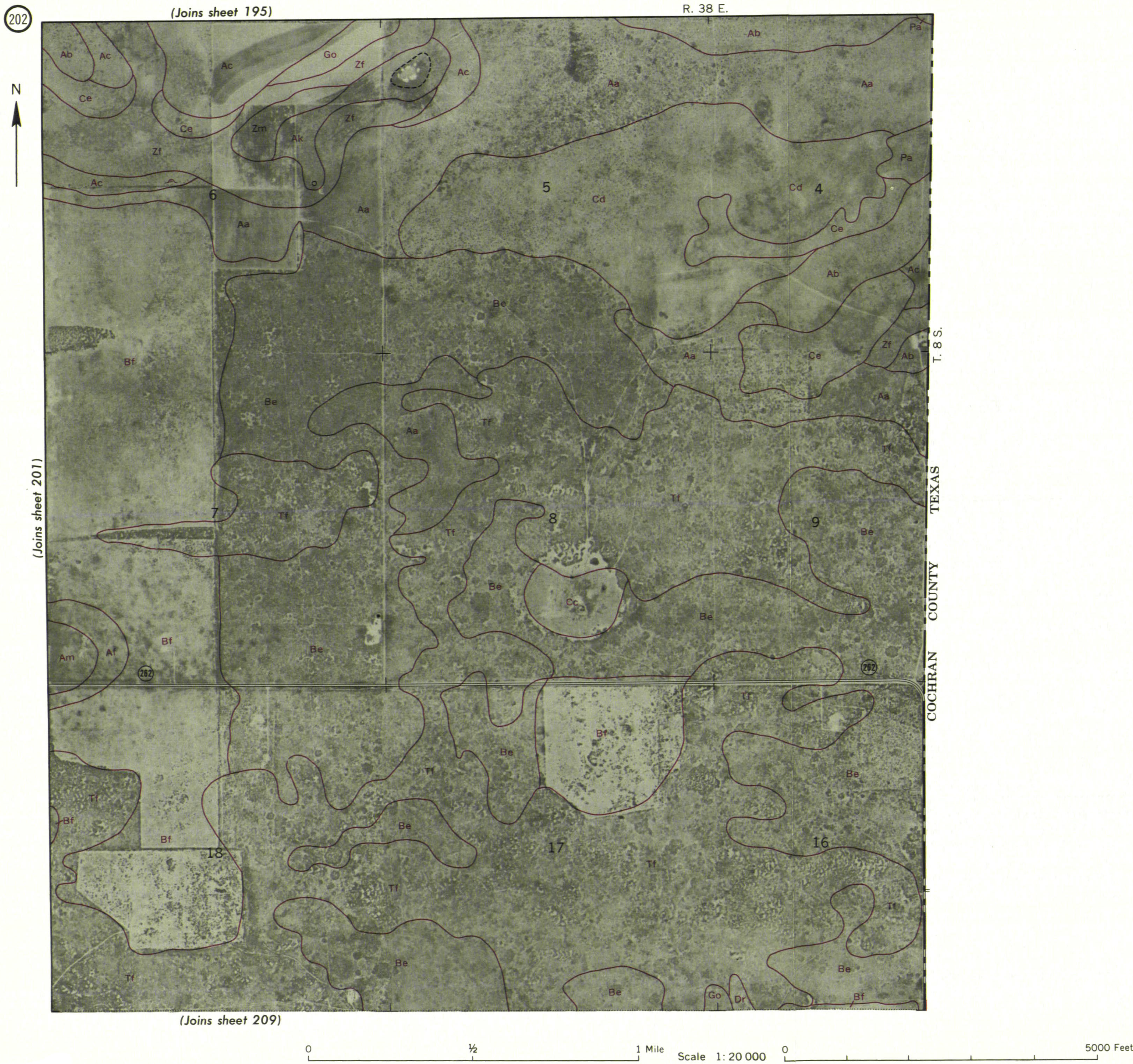

200
(Joins sheet 193)
R. 36 E. | R. 37 E.
N
T. 8 S.
(Joins sheet 199)
(Joins sheet 201)
(Joins sheet 207)
2
1
6
5
11
12
7
8
14
13
18
17
262
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

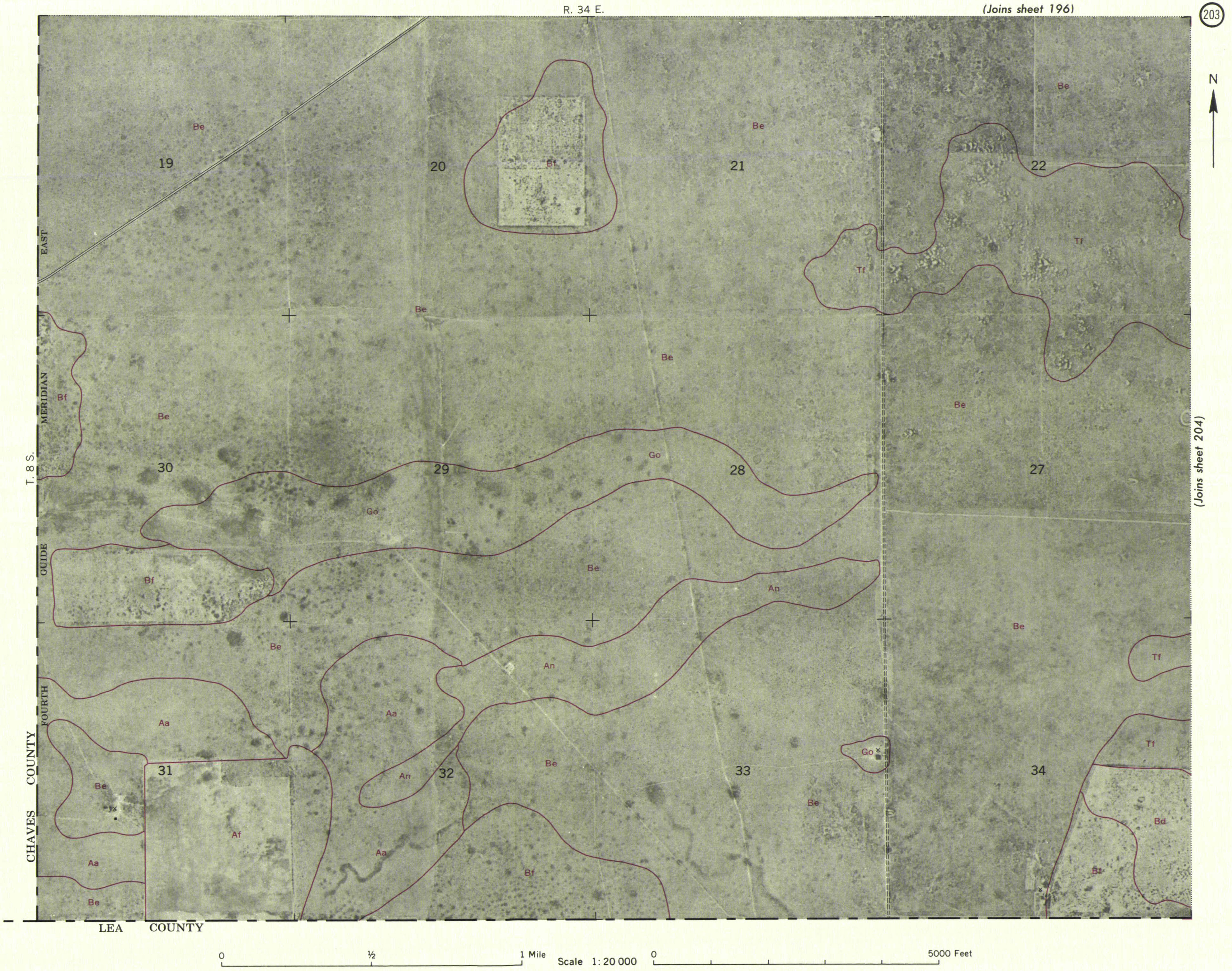


This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


202
(Joins sheet 195)
R. 38 E.
N
(Joins sheet 201)
T. 8 S.
TEXAS
COCHRAN COUNTY
(Joins sheet 209)
6
5
4
7
8
9
18
17
16
Ab
Ac
Ce
Go
Zf
Zm
Ak
Aa
Cd
Pa
Be
Bf
Tf
Cc
Am
Af
Dr
262
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

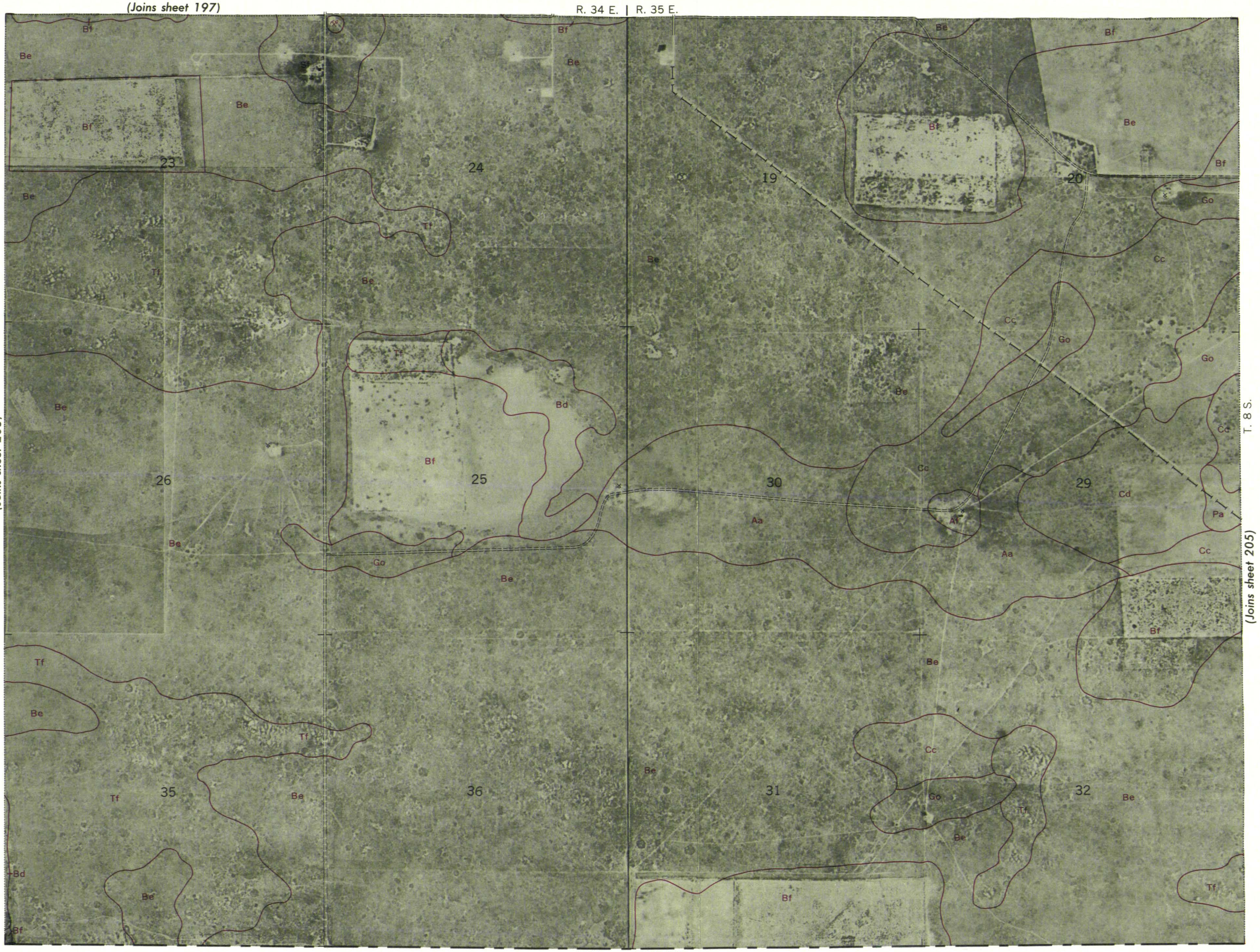
204

(Joins sheet 197)

R. 34 E. | R. 35 E.

N

(Joins sheet 203)

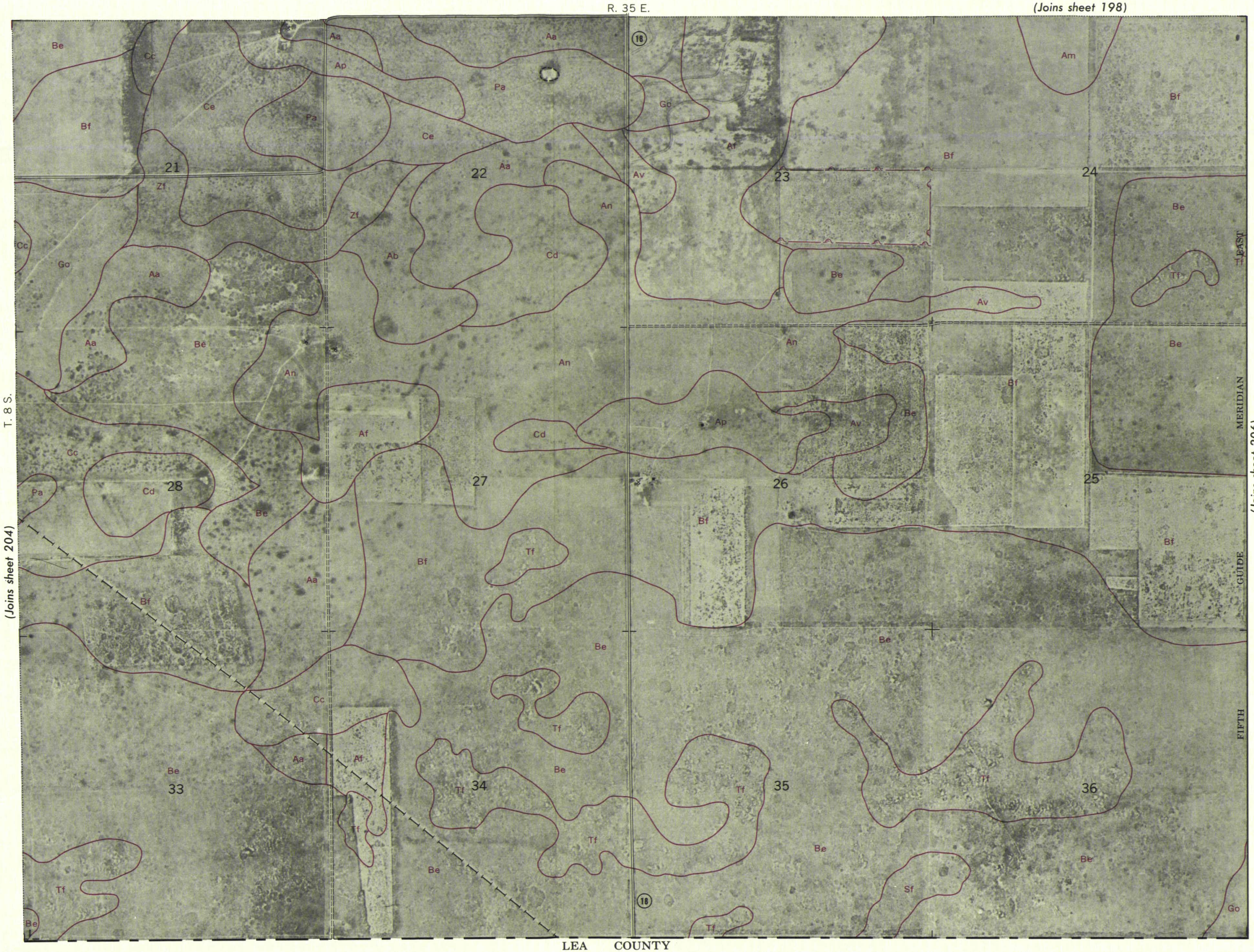


T. 8 S.

(Joins sheet 205)

LEA COUNTY

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

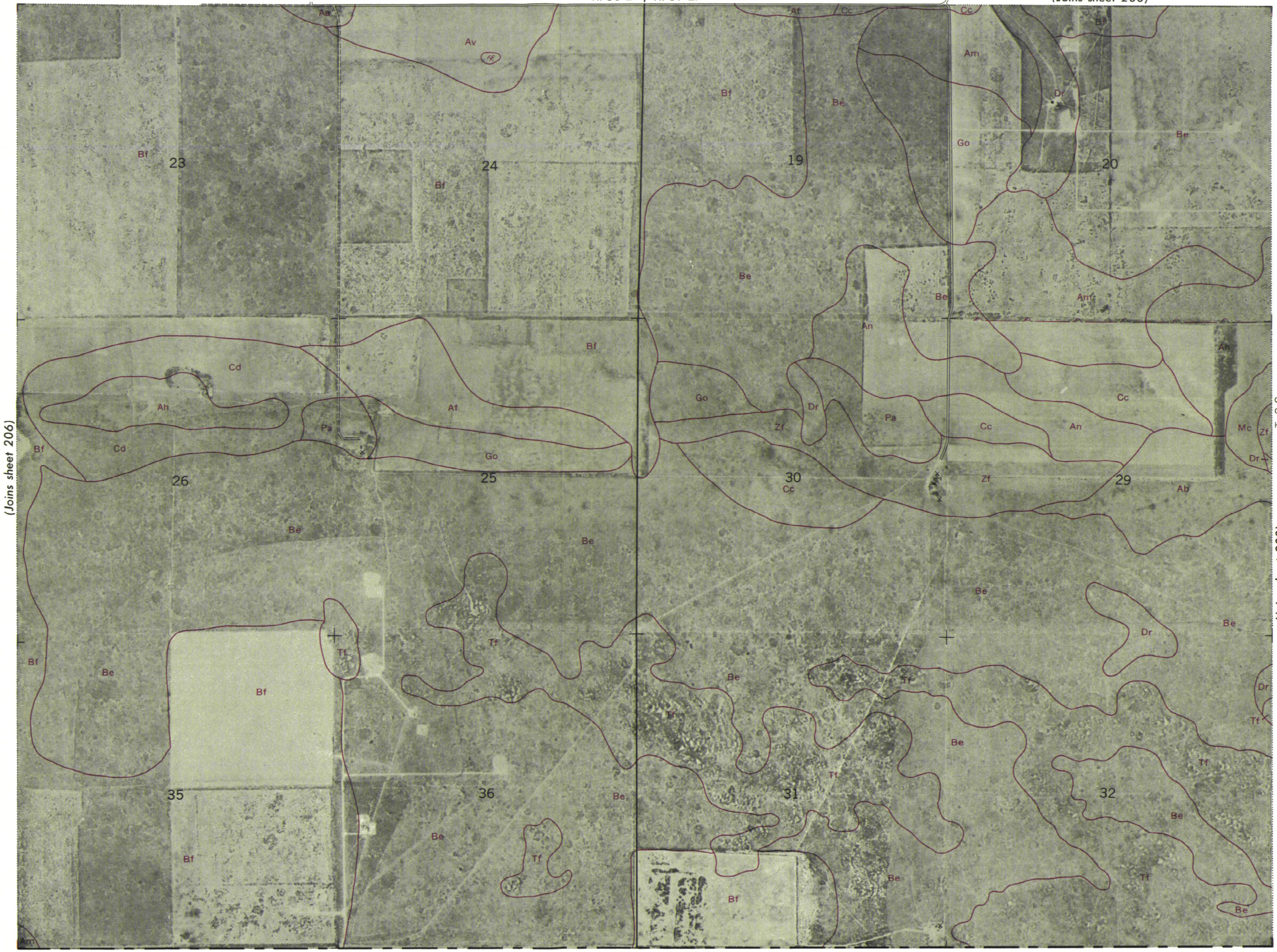


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


206
(Joins sheet 199)
R. 36 E.
N
(Joins sheet 205)
(Joins sheet 207)
T. 8 S.
EAST MERIDIAN
GUIDE
FIFTH
LEA COUNTY
19
20
21
22
30
29
28
27
31
32
33
34
Bf
Be
Av
Go
Am
Tf
Sp
Sf
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet



LEA COUNTY

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 208

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

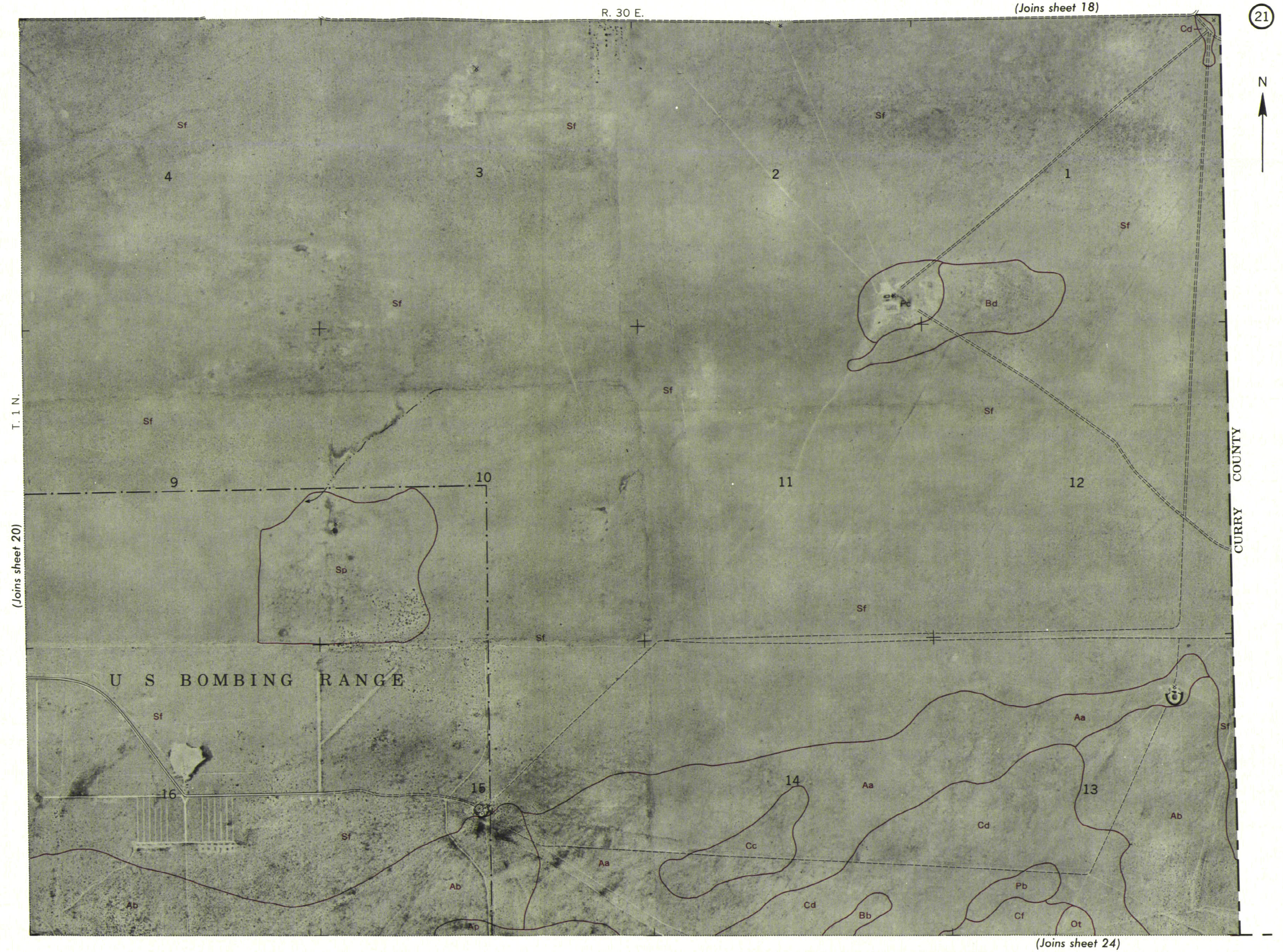
209

N

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

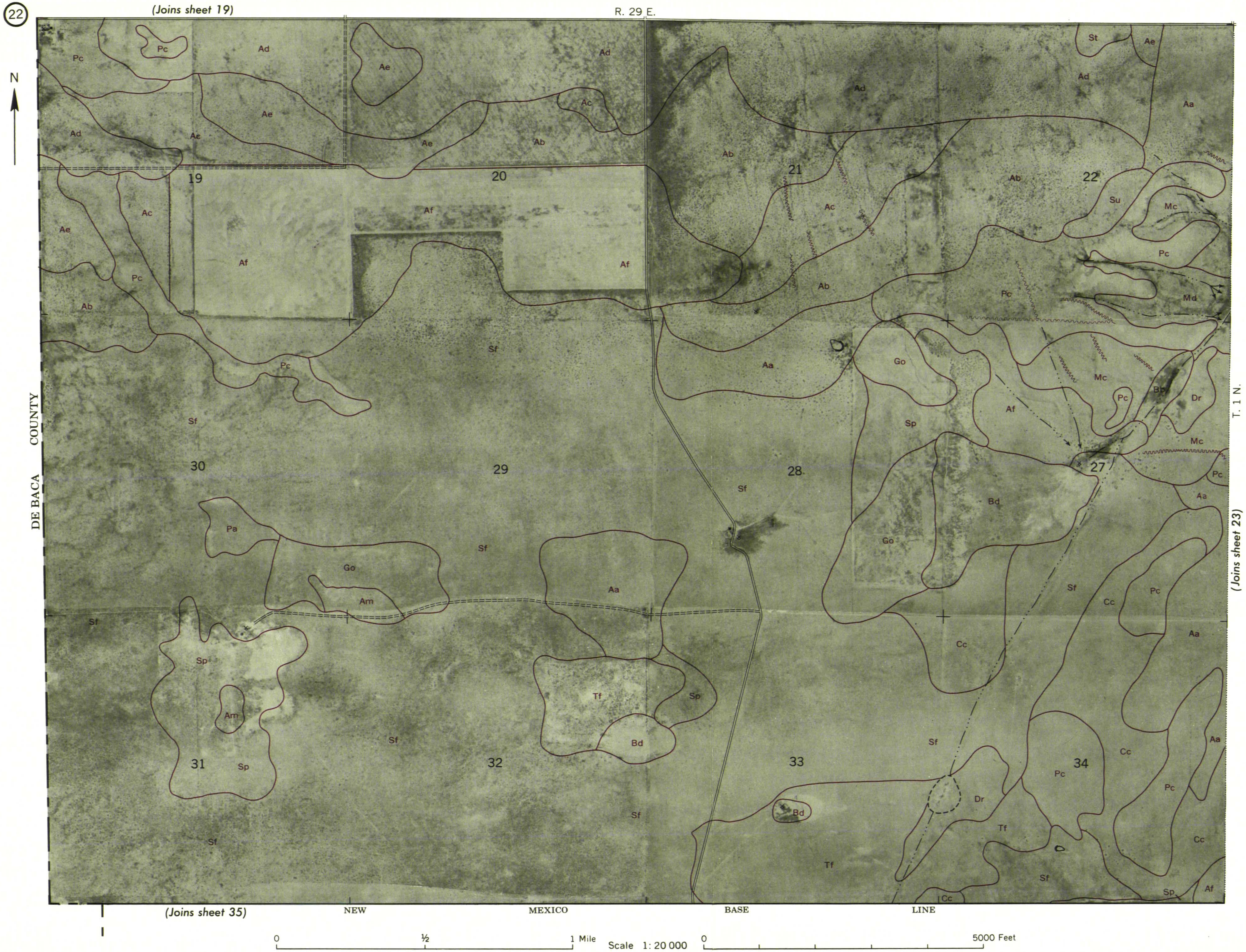
Range, township, and section corners shown on this map are indefinite.



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

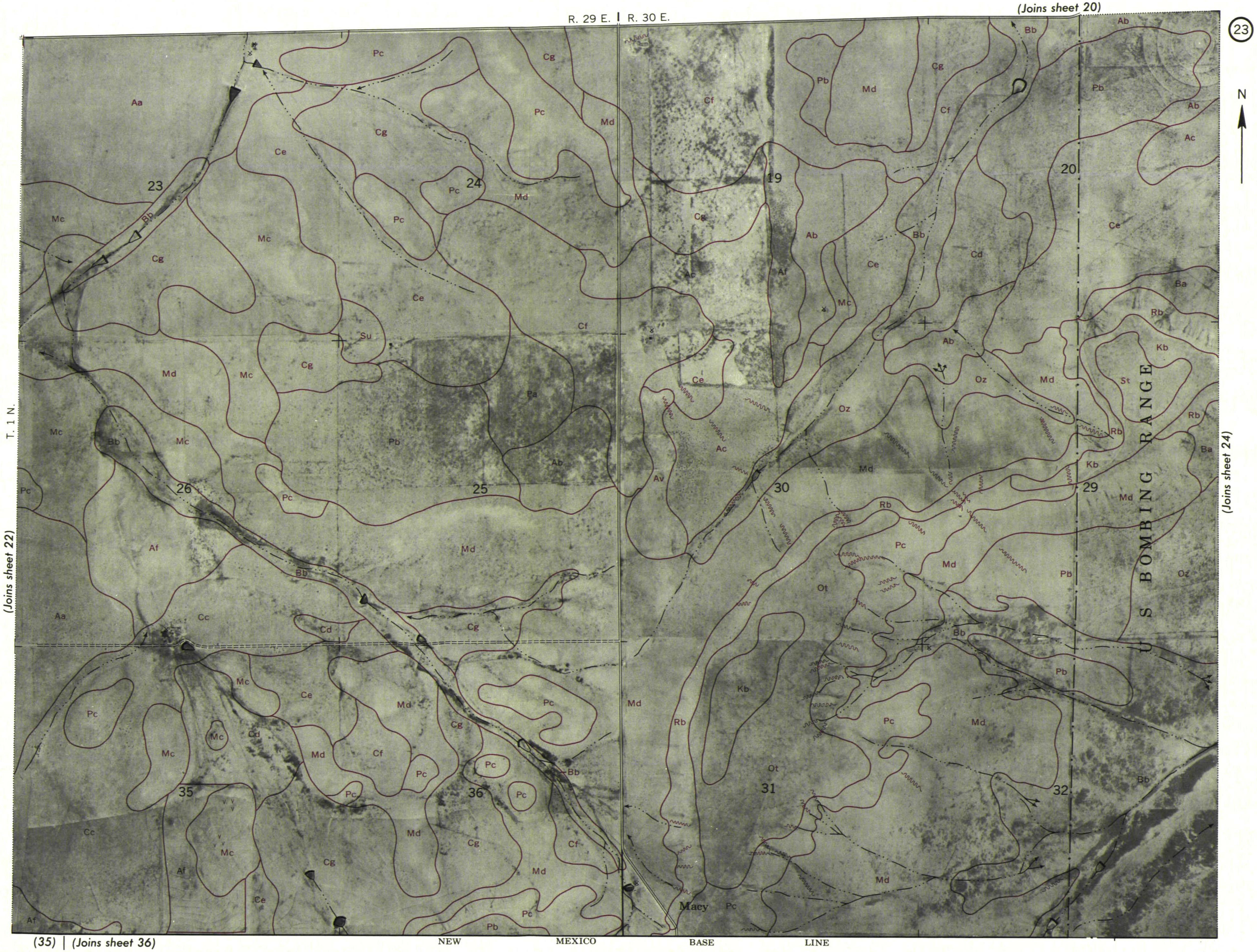
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

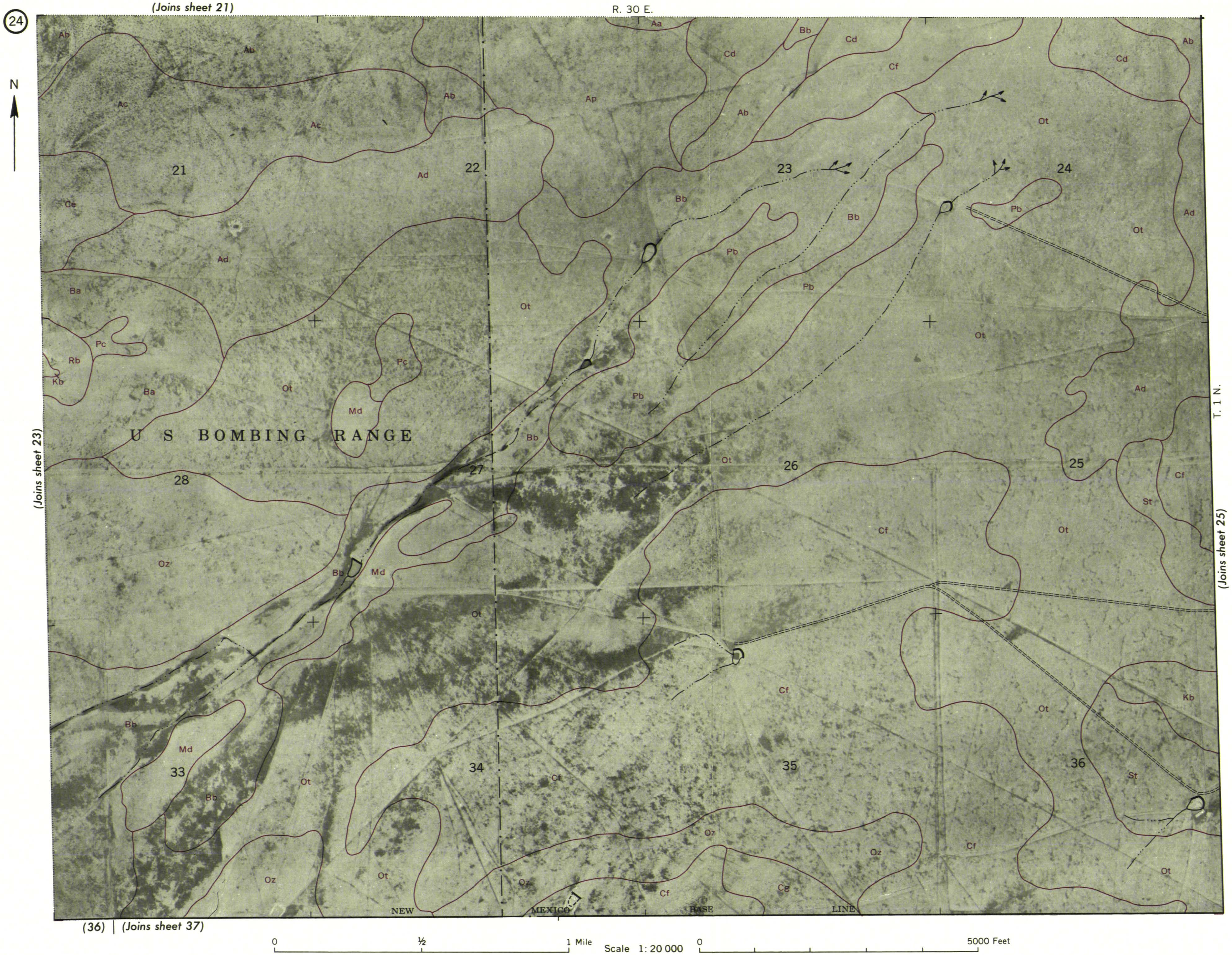

22
(Joins sheet 19)
R. 29 E.
N
DE BACA COUNTY
T. 1 N.
(Joins sheet 23)
(Joins sheet 35)
NEW
MEXICO
BASE
LINE
19
20
21
22
30
29
28
27
31
32
33
34
Pc
Ad
Ae
Ac
Ab
Af
Sf
Aa
St
Su
Mc
Md
Go
Sp
Bb
Dr
Bd
Cc
Pa
Am
Tf
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



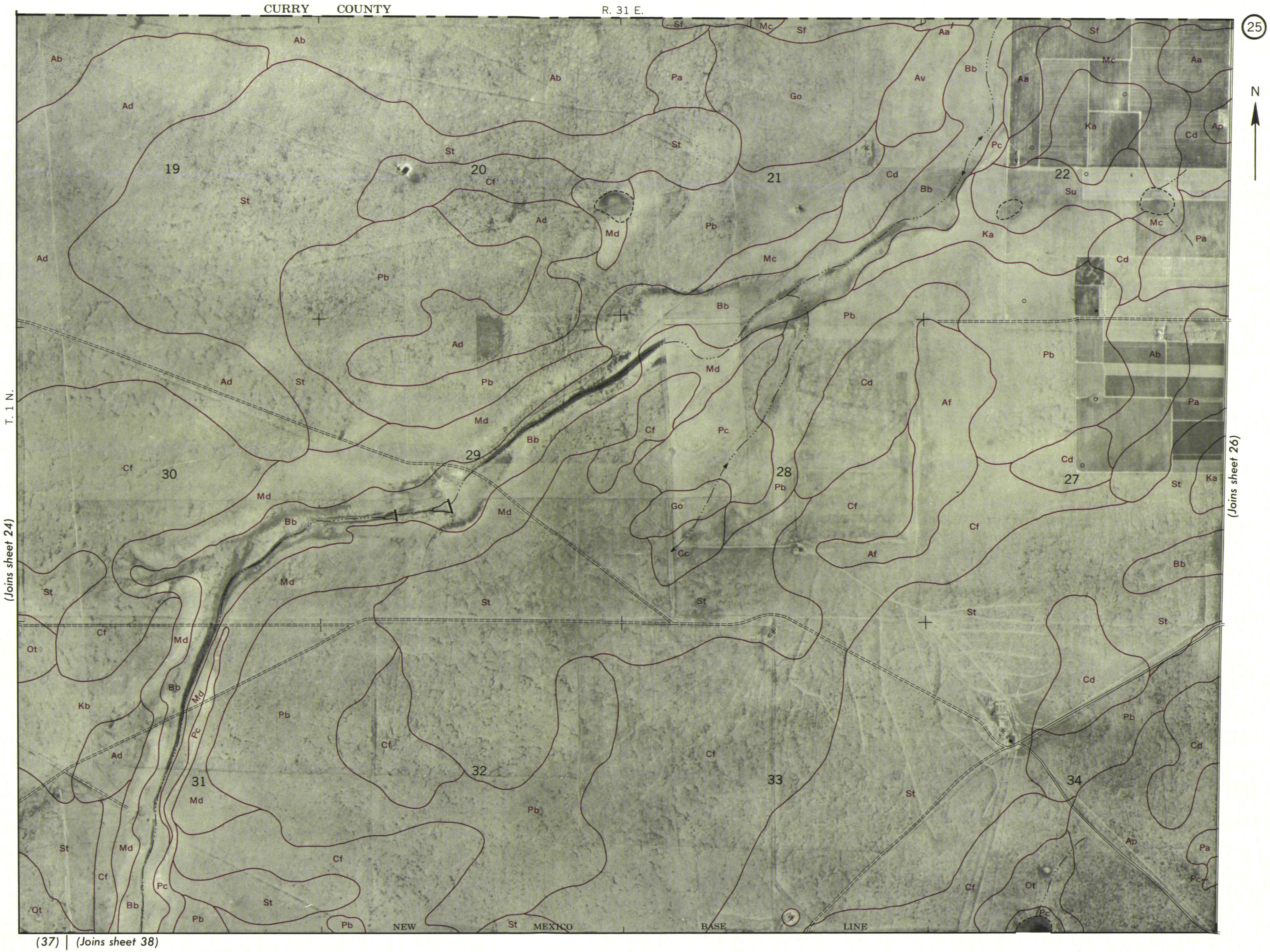
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



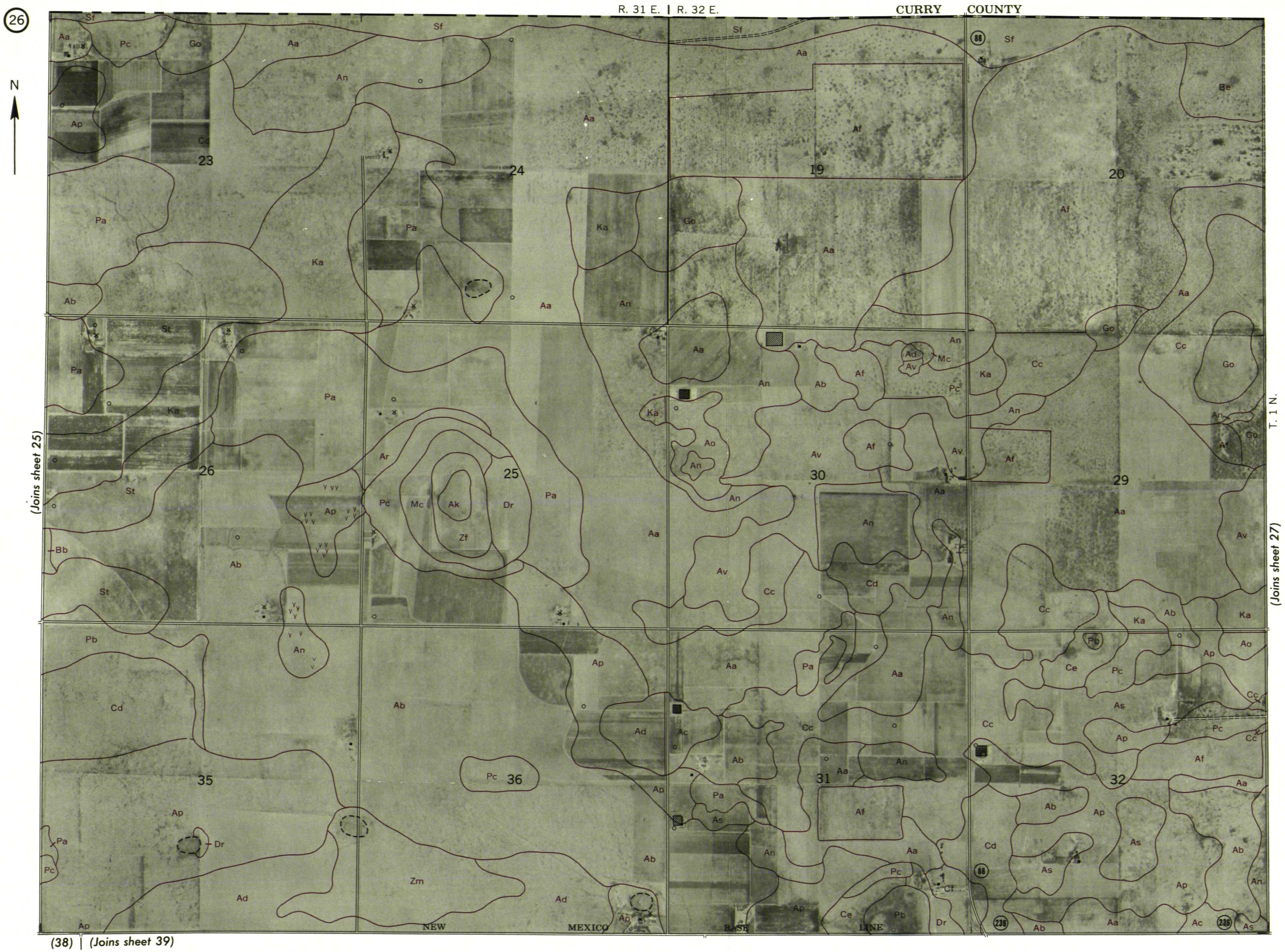
24
(Joins sheet 21)
R. 30 E.
N
(Joins sheet 23)
(Joins sheet 25)
T. 1 N.
U S BOMBING RANGE
21
22
23
24
25
26
27
28
33
34
35
36
NEW MEXICO BASE LINE
(36) | (Joins sheet 37)
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



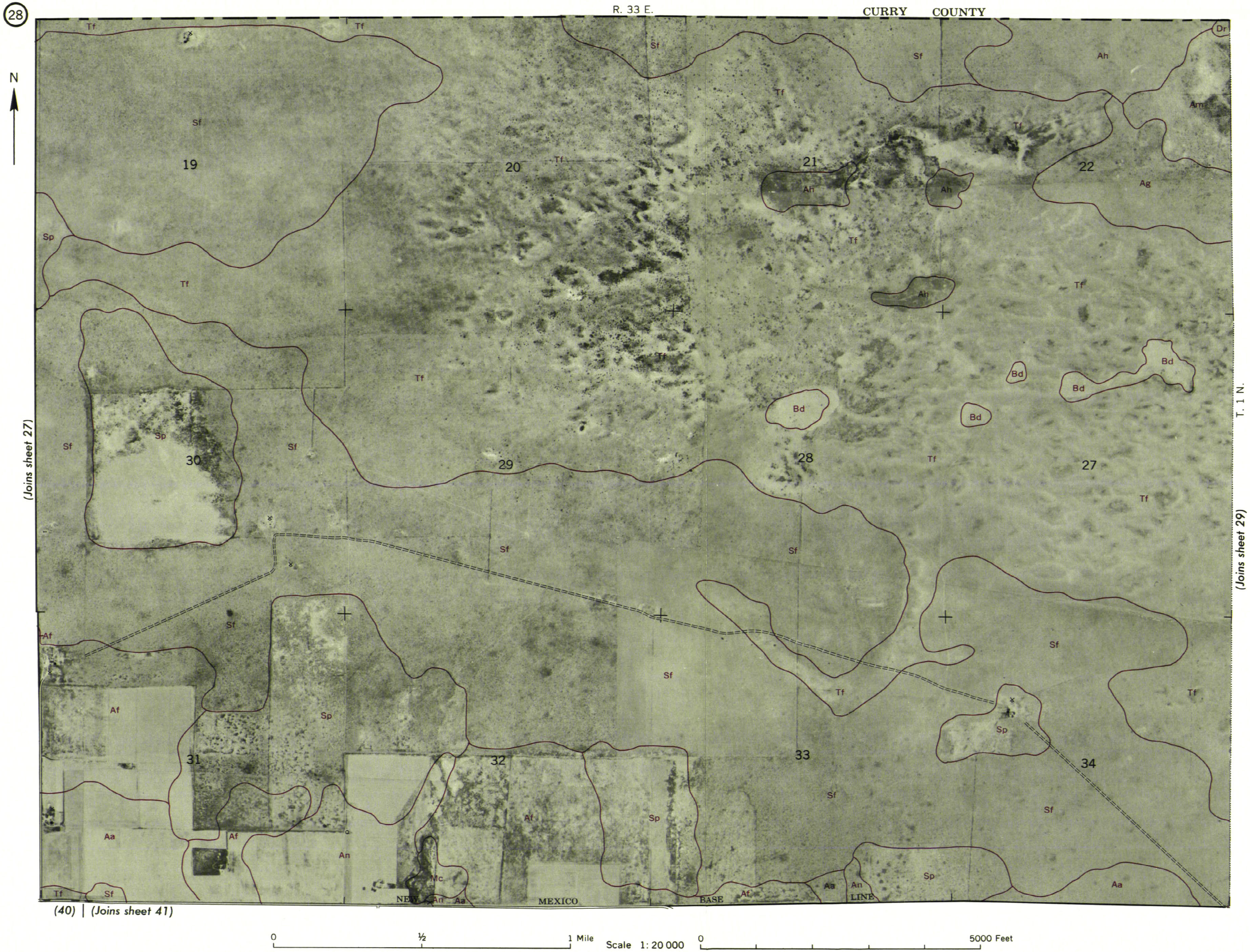
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(27)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite


28
R. 33 E.
CURRY COUNTY
N
T. 1 N.
(Joins sheet 27)
(Joins sheet 29)
(40) | (Joins sheet 41)
NEW MEXICO BASE LINE
19
20
21
22
27
28
29
30
31
32
33
34
Tf
Sf
Sp
Ah
Ag
Am
Dr
Bd
Af
Aa
An
Mc
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

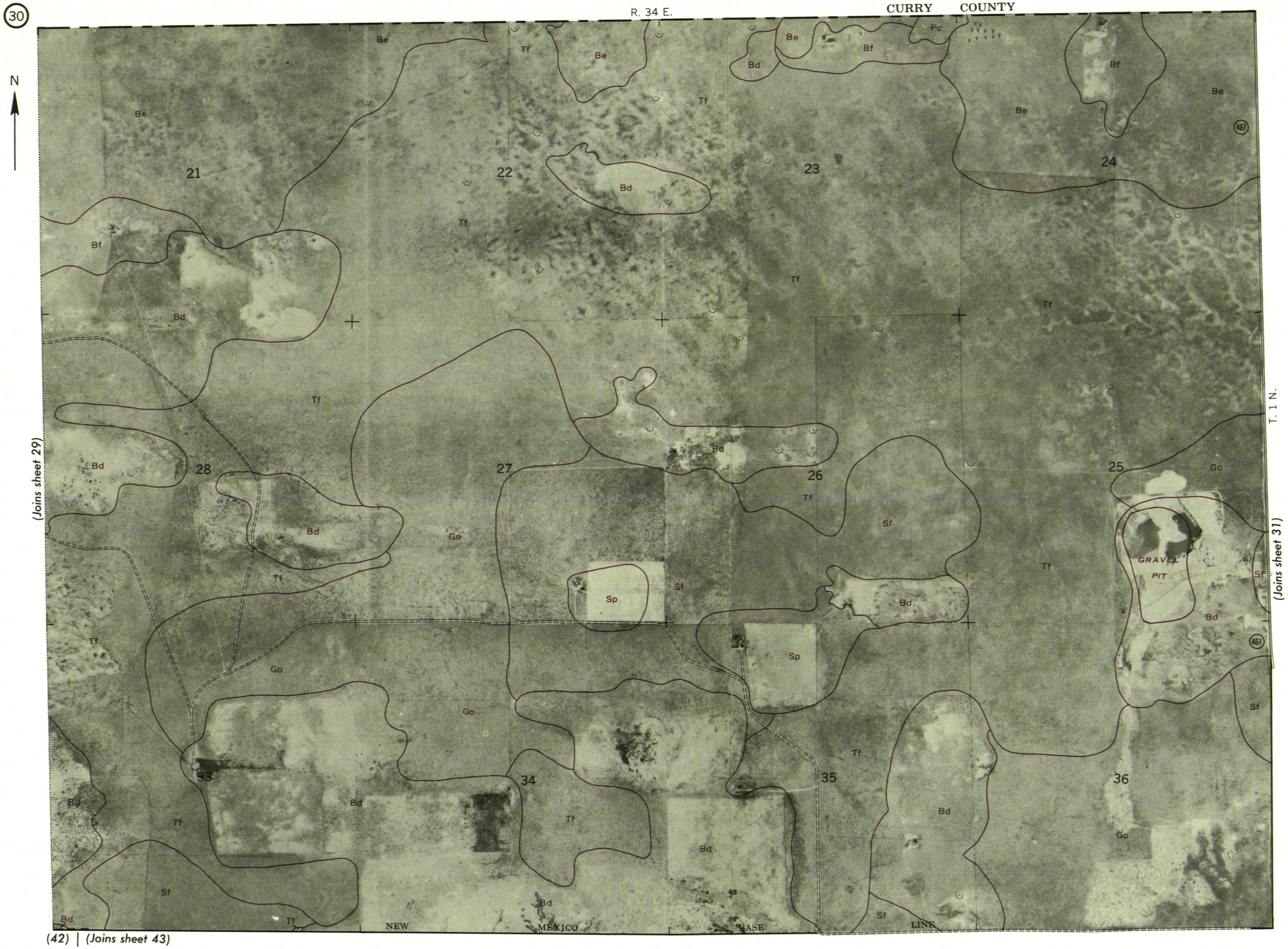
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 3

3

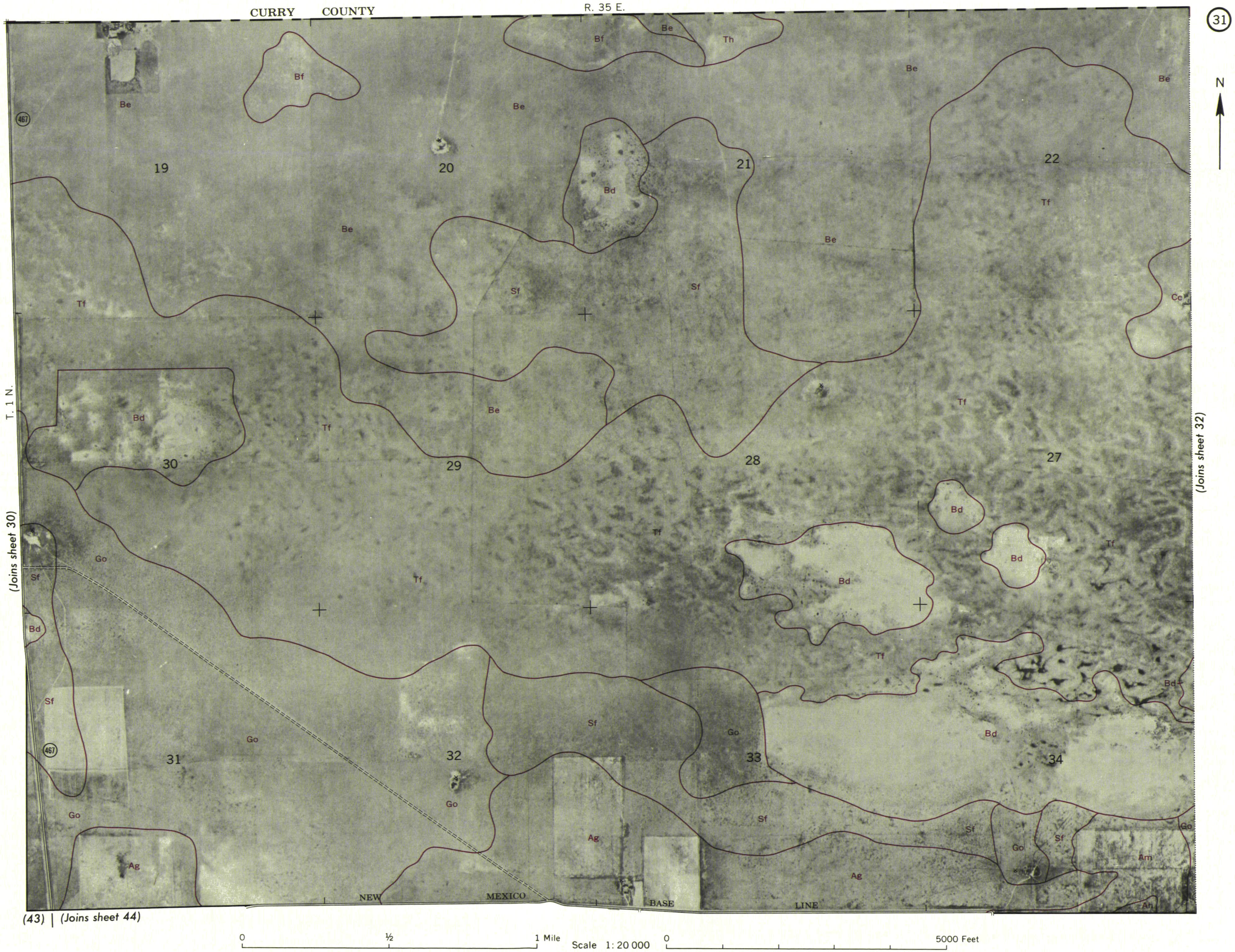
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

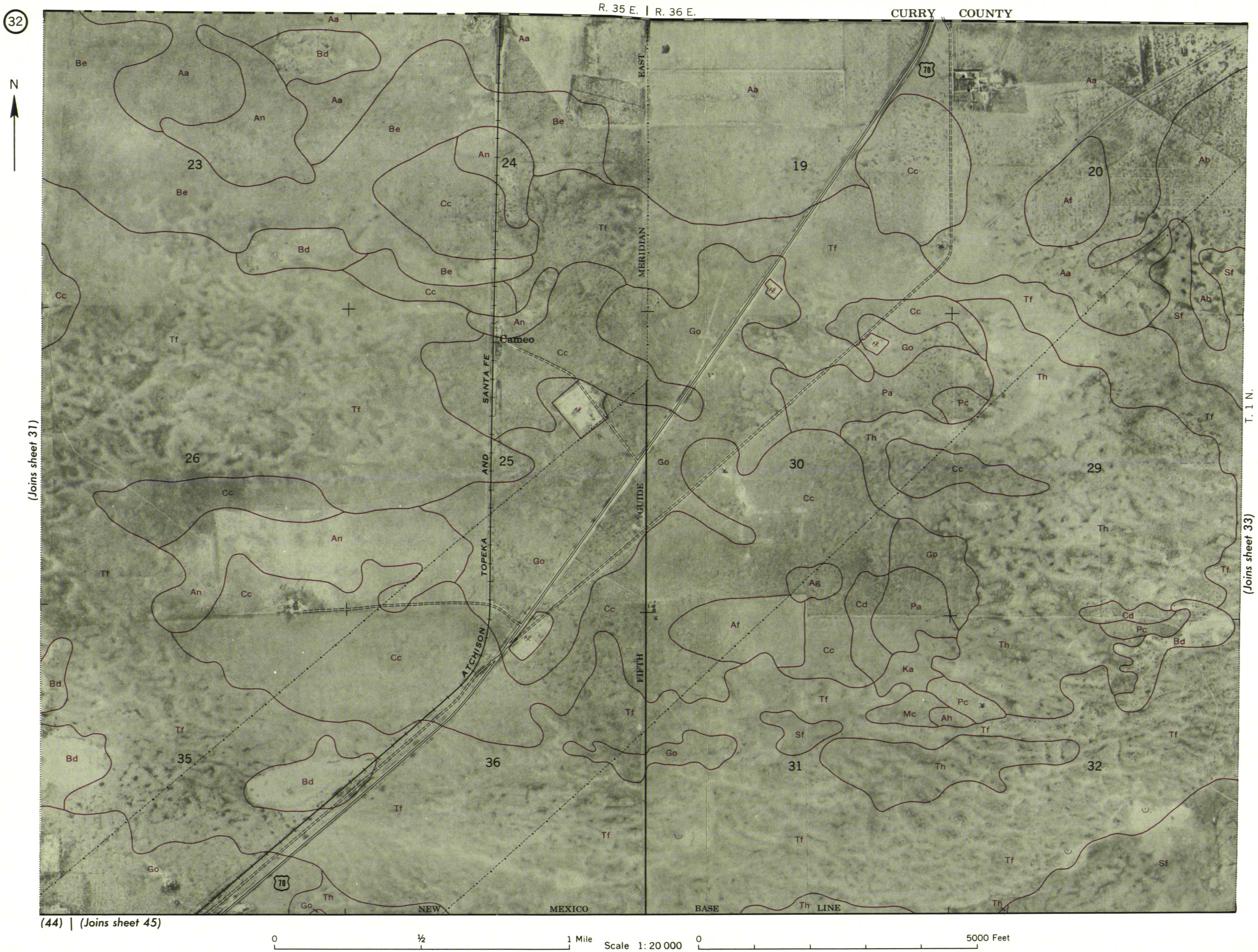


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

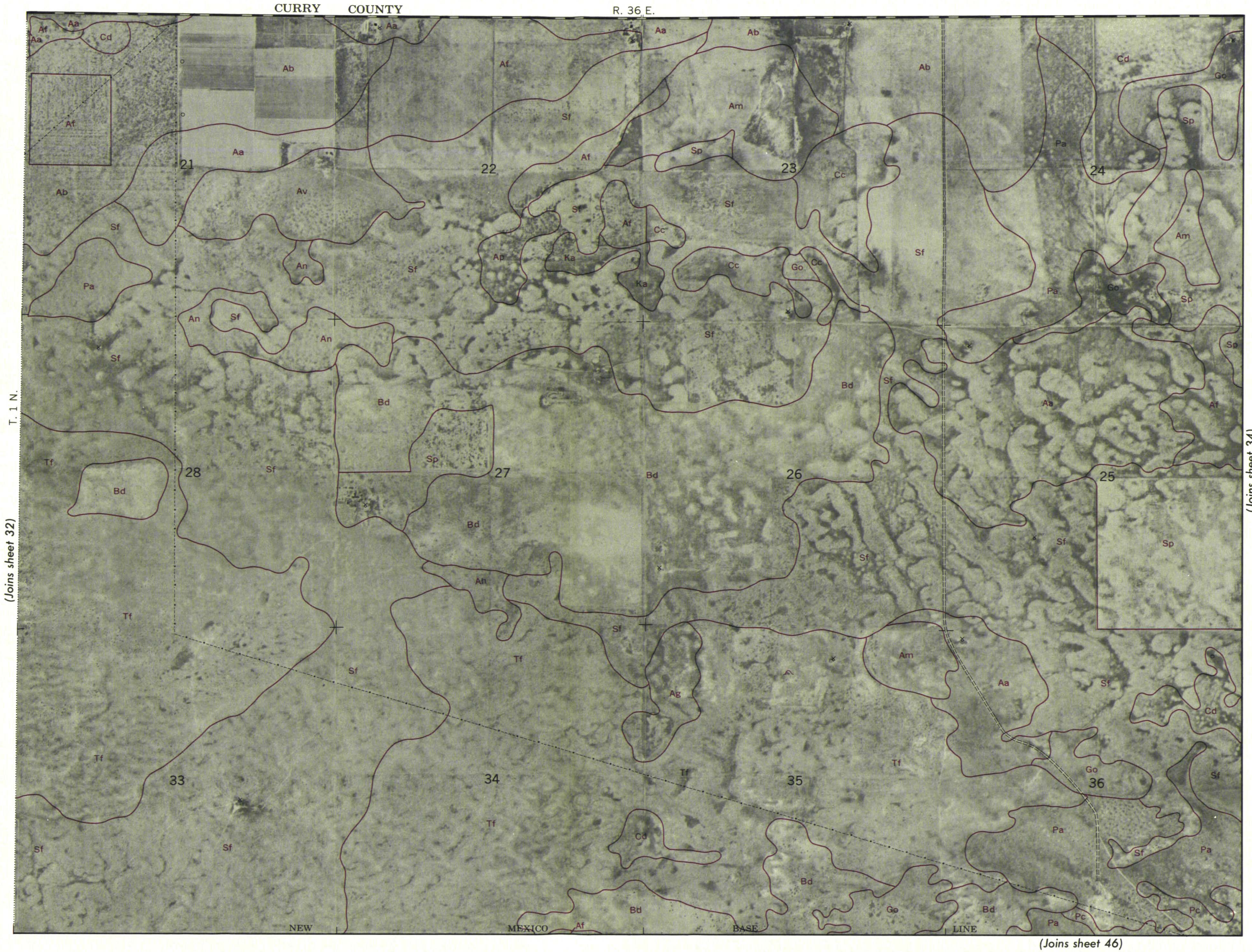
Range, township, and section corners shown on this map are indefinite.


32
N
R. 35 E. | R. 36 E.
CURRY COUNTY
T. 1 N.
(Joins sheet 31)
(Joins sheet 33)
(44) | (Joins sheet 45)
EAST MERIDIAN
FIFTH GUIDE
ATCHISON TOPEKA AND SANTA FE
Cameo
70
NEW MEXICO BASE LINE
23
24
19
20
26
25
30
29
35
36
31
32
Aa
Ab
Af
Ag
Ah
An
Bd
Be
Cc
Cd
Go
Gp
Ka
Mc
Pa
Pc
Sf
Tf
Th
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

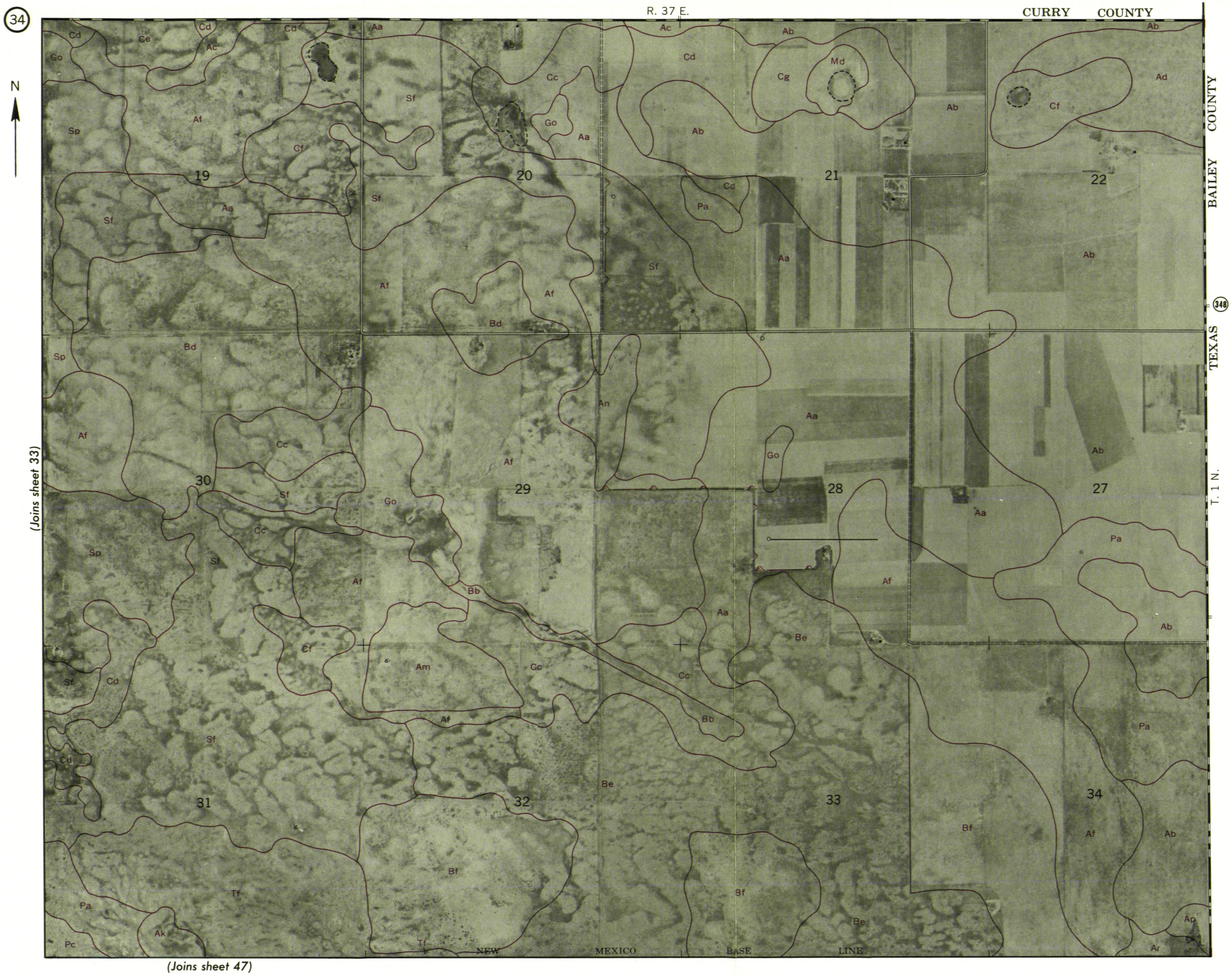
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 33

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

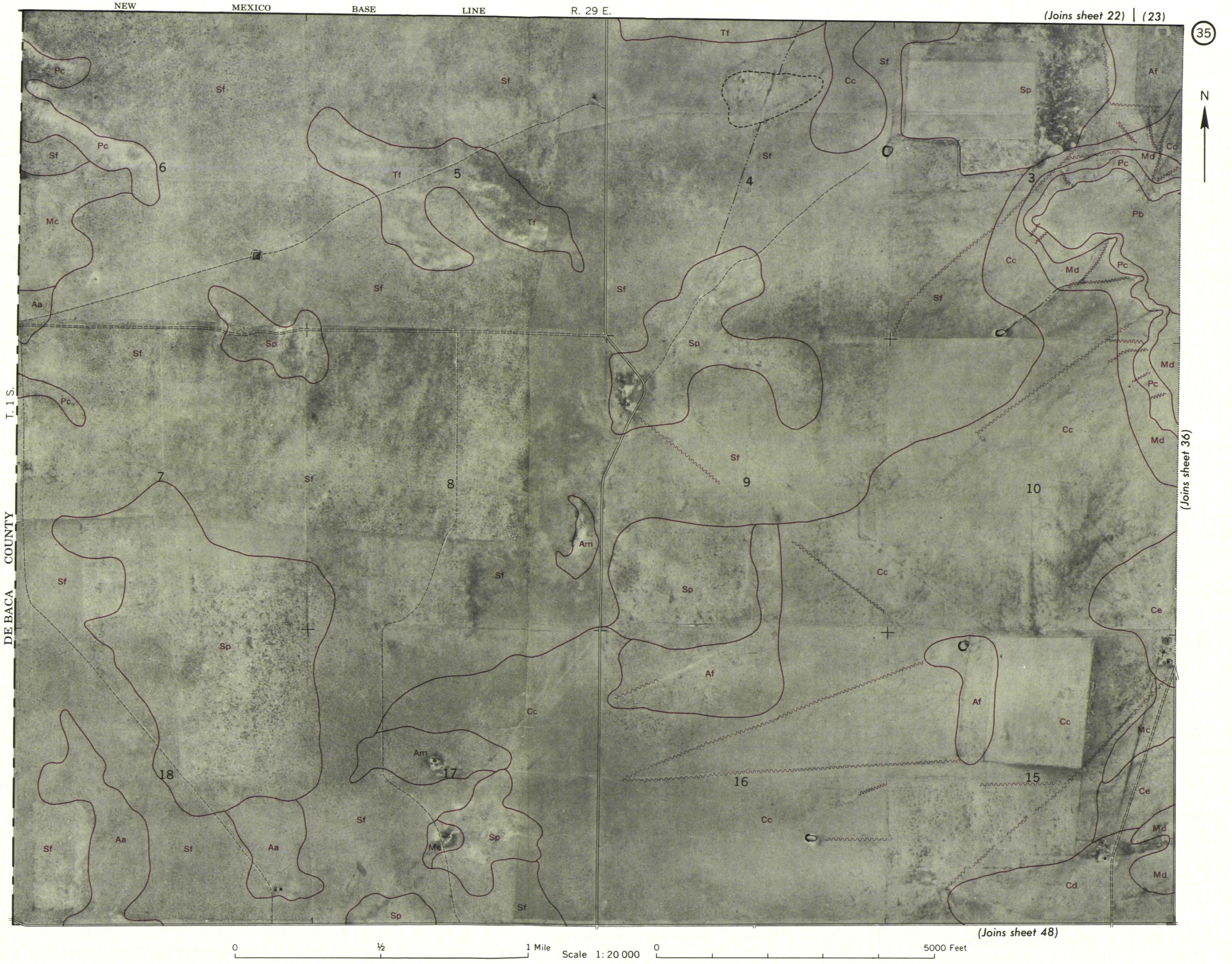
Range, township, and section corners shown on this map are indefinite



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

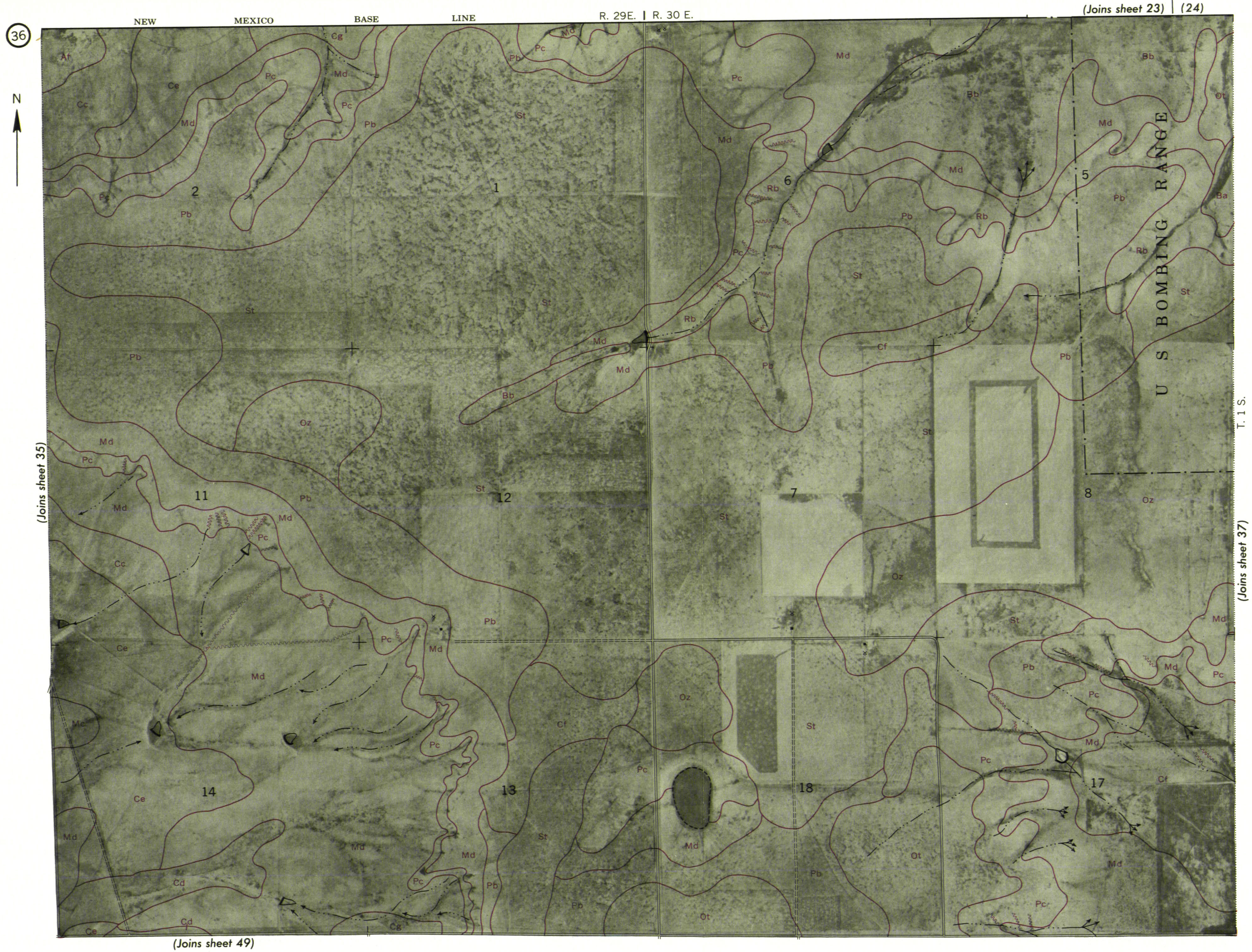


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

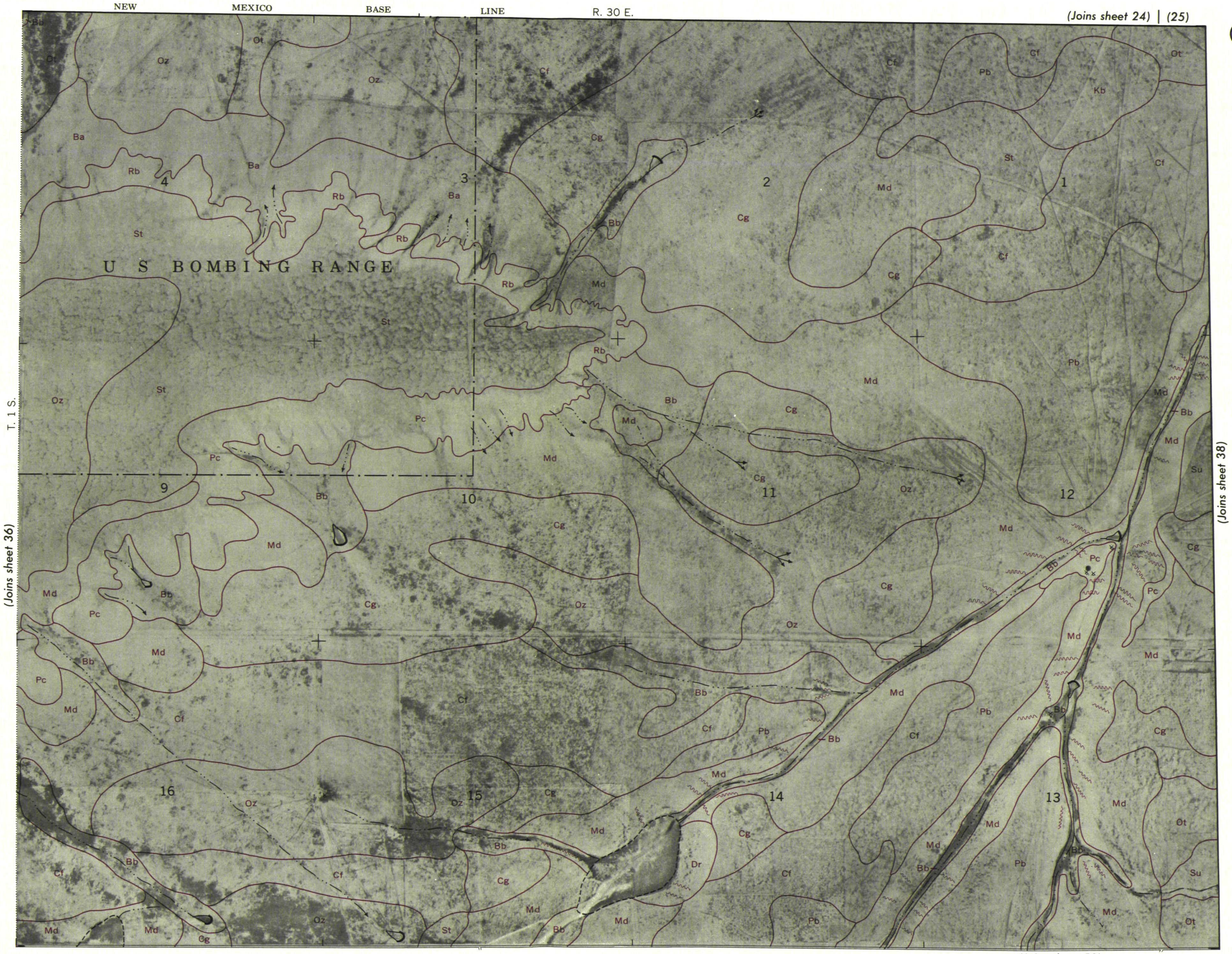


This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



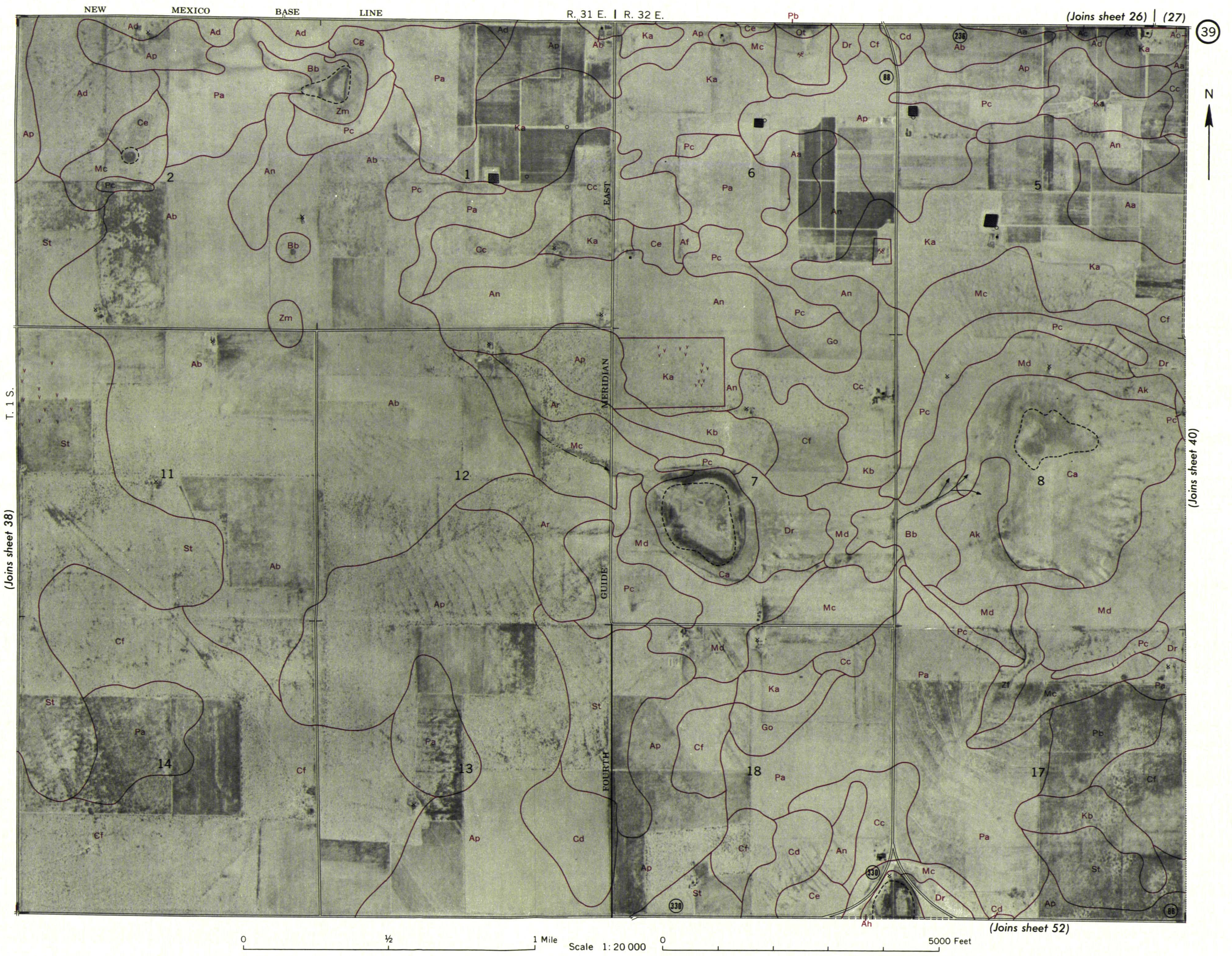
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

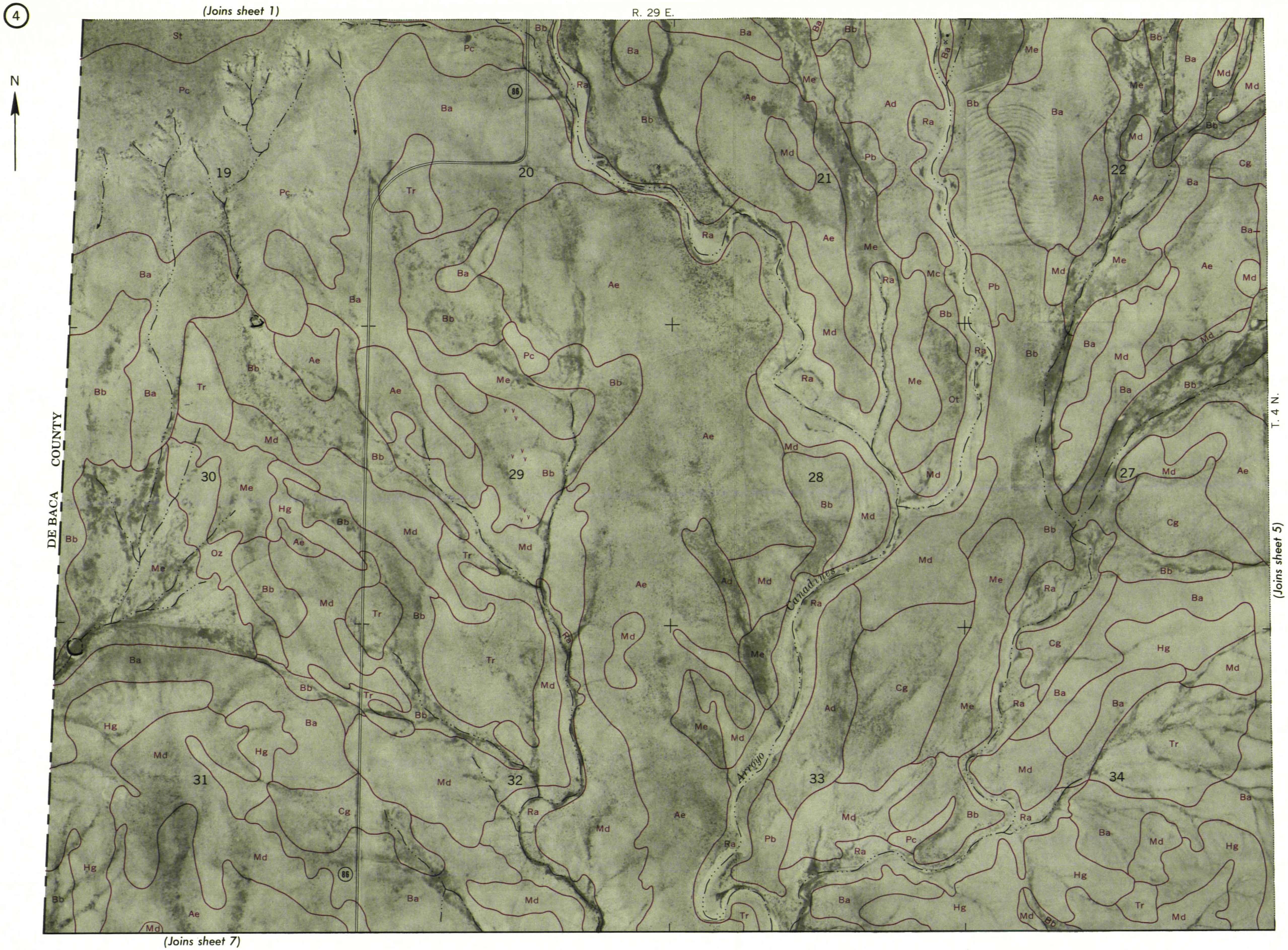
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 38

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 40

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

(Joins sheet 29) | (30)

(Joins sheet 55)

Scale 1: 20 000

0 ½ 1 Mile

0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

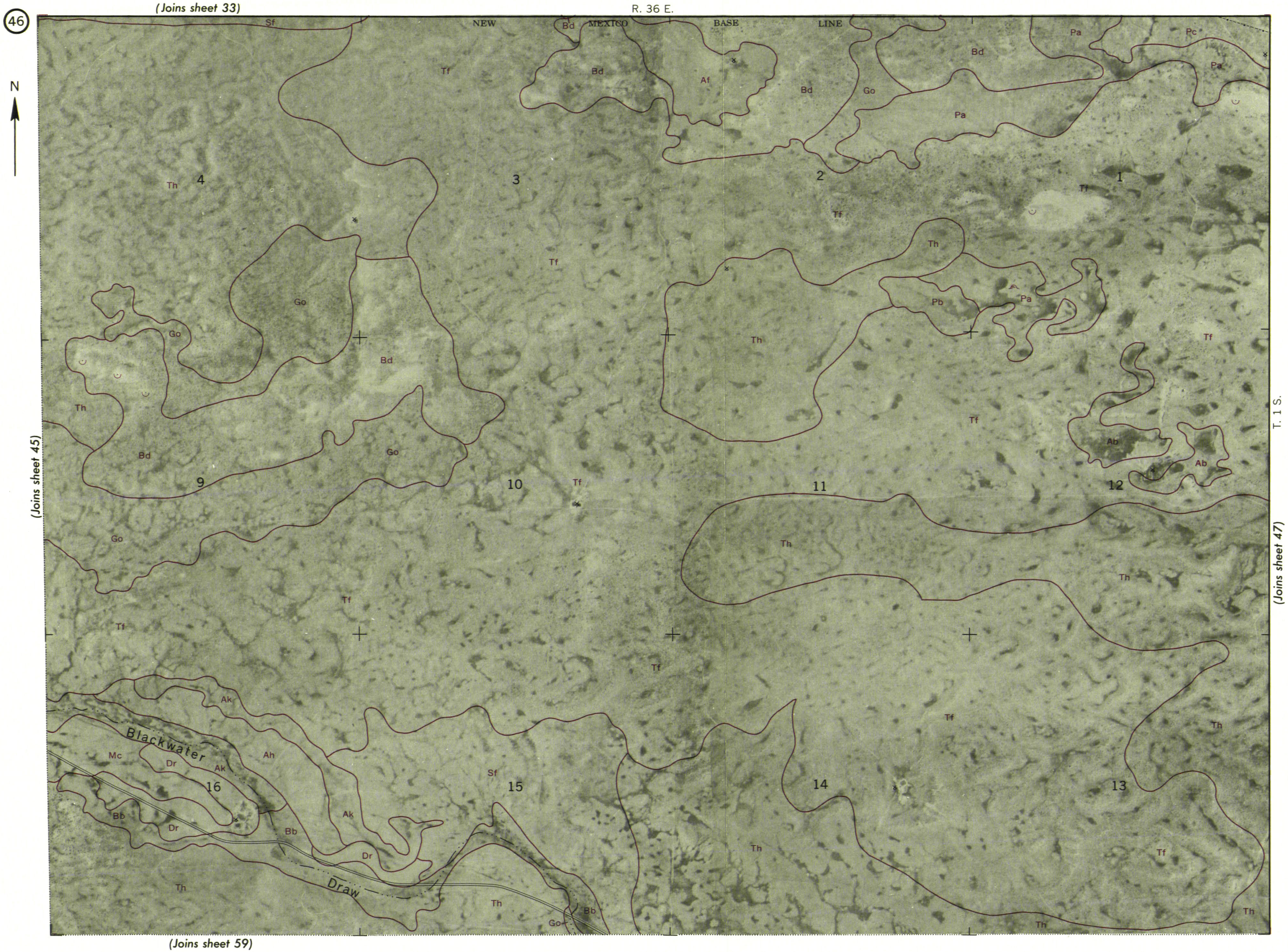
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

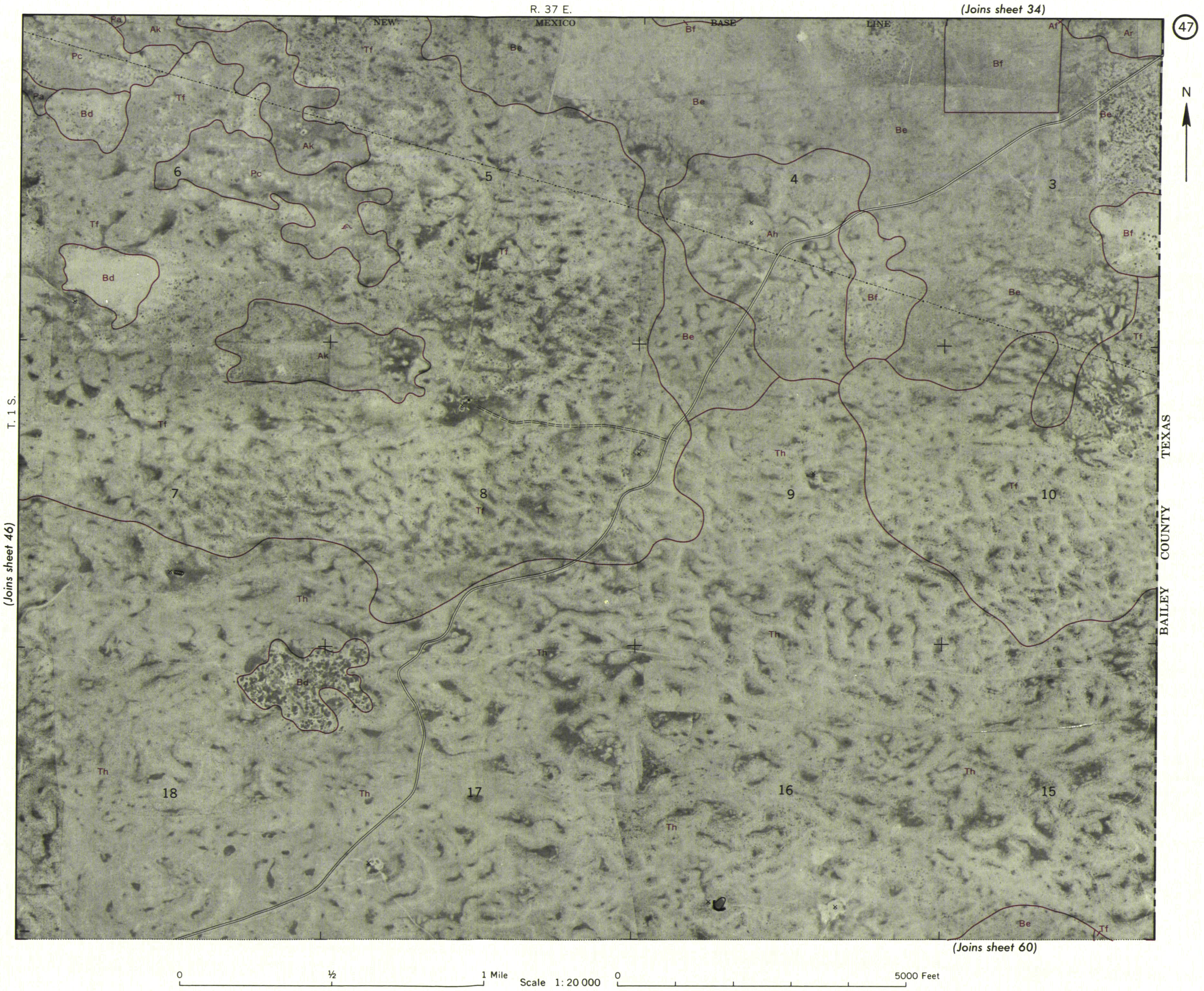
44
NEW MEXICO BASE LINE
R. 35 E.
(Joins sheet 31) | (32)
N
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 59)
T. 1 S.
Blackwater Draw
Blackwater Draw
ATCHISON TOPEKA AND SANTA FE
467
70
6
5
4
3
7
8
9
10
18
17
16
15
Go
Ag
Am
Ah
Pa
Tf
Bd
Sf
Bf
Aa
Ab
Af
Cd
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



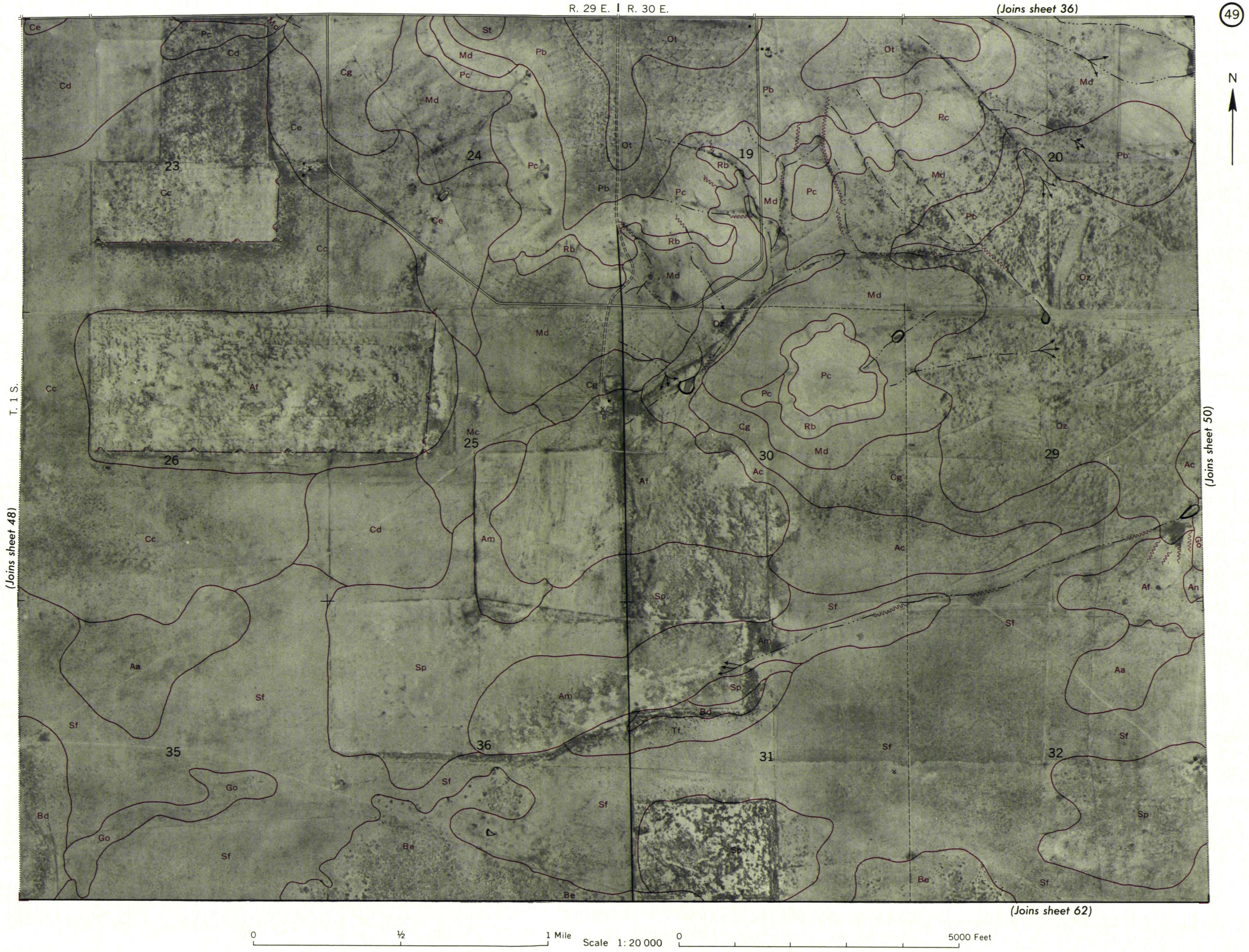
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


48
(Joins sheet 35)
R. 29 E.
N
T. 1 S.
(Joins sheet 49)
(Joins sheet 61)
DE BACA COUNTY
19
20
21
22
27
28
29
30
31
32
33
34
Aa
Af
Am
An
Av
Bd
Be
Bf
Cc
Cd
Go
Sf
Sp
Tf
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



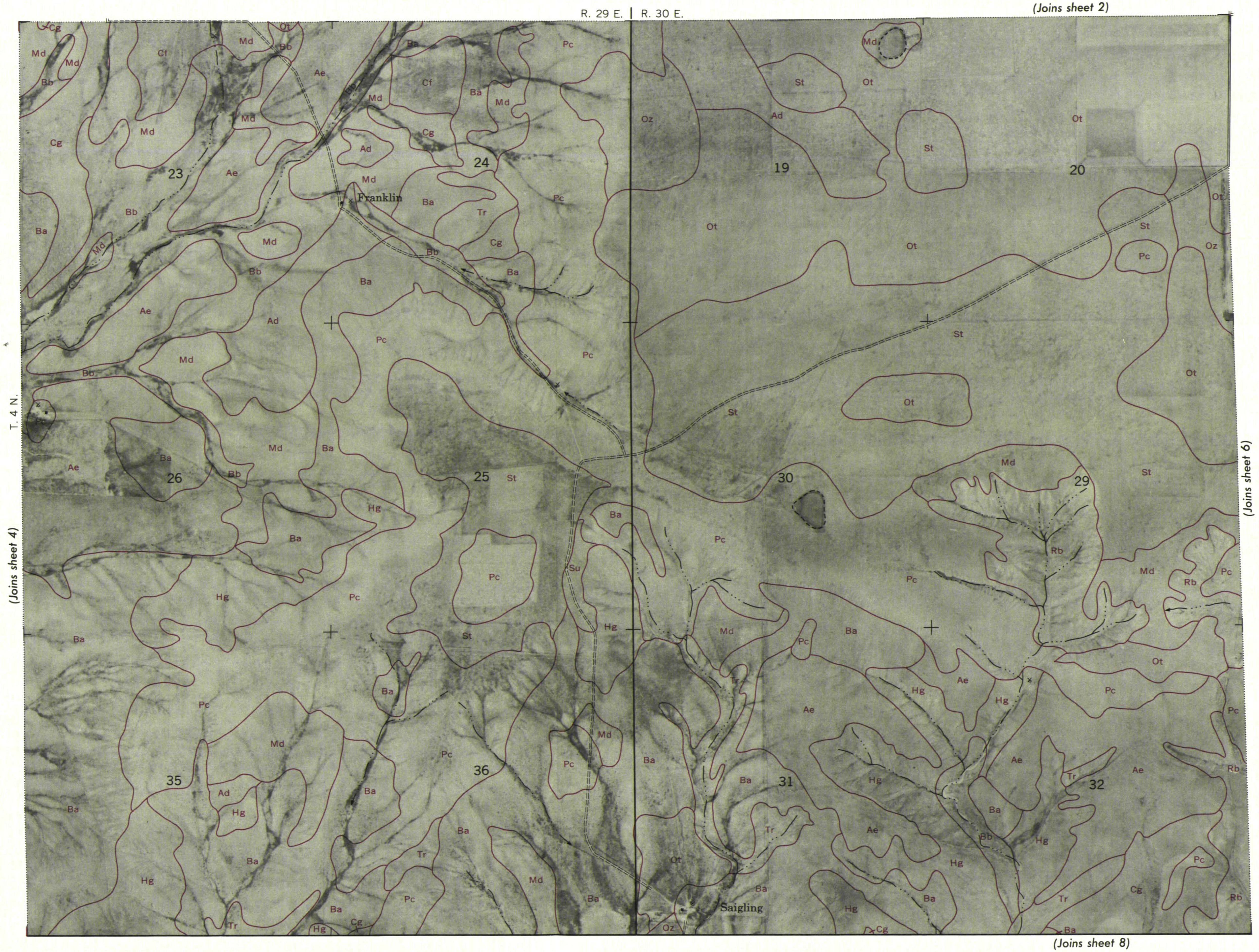
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

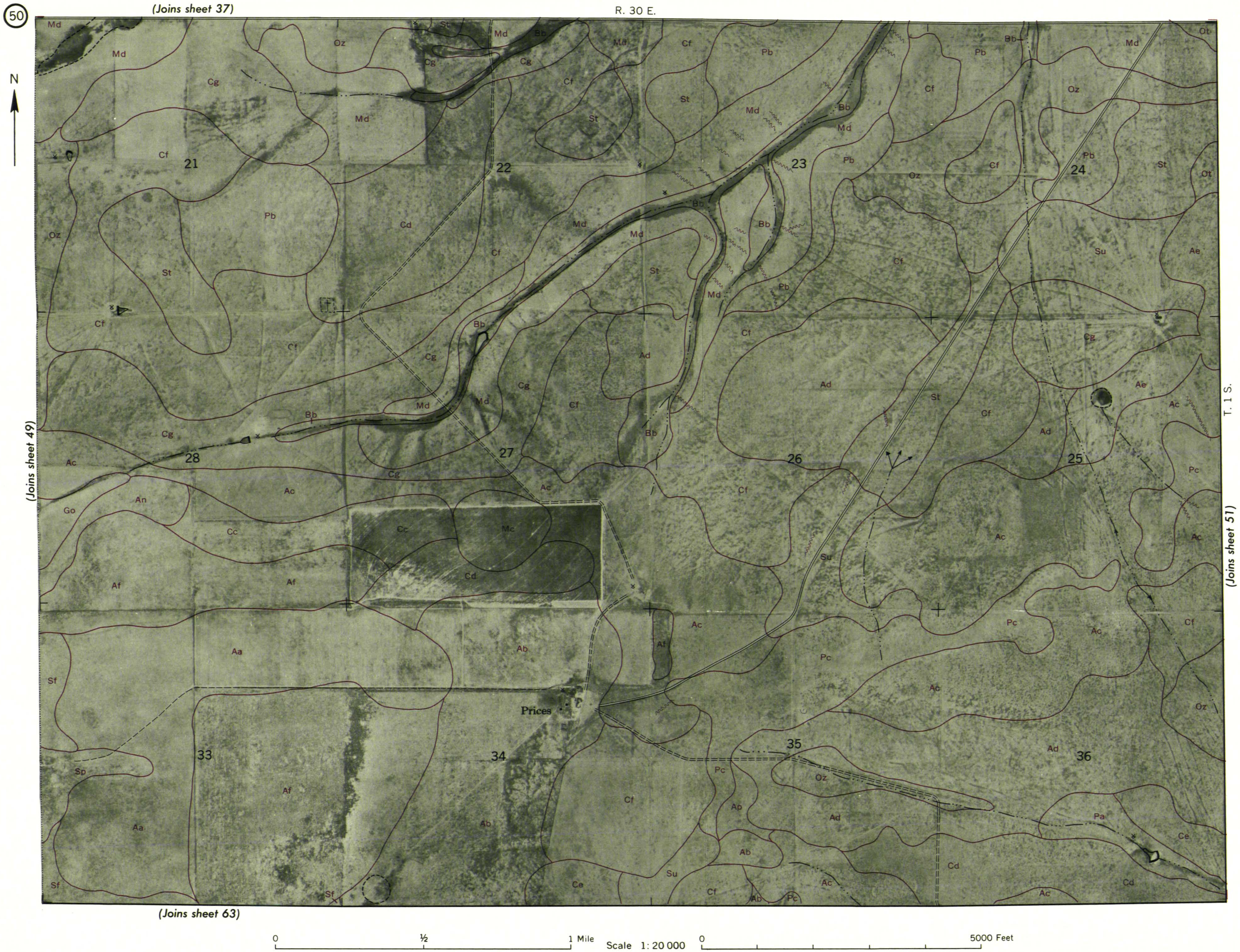
5

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


50
(Joins sheet 37)
R. 30 E.
N
(Joins sheet 49)
T. 1 S.
(Joins sheet 51)
(Joins sheet 63)
21
22
23
24
28
27
26
25
33
34
35
36
Prices
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

R. 31 E.

(Joins sheet 38)

51

N

T. 1 S.

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 64)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

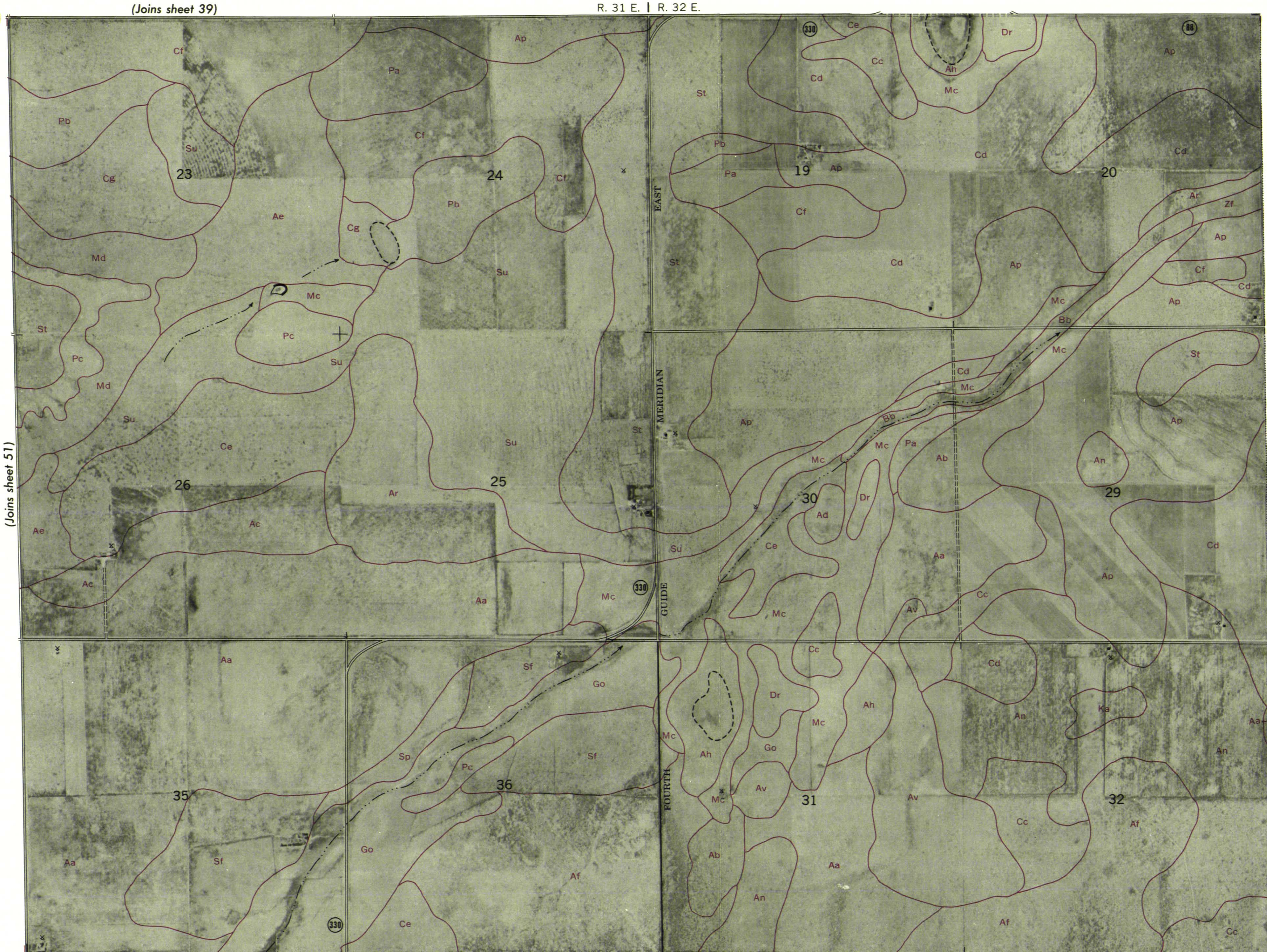
Range, township, and section corners shown on this map are indefinite.

52

(Joins sheet 39)

R. 31 E. | R. 32 E.

N



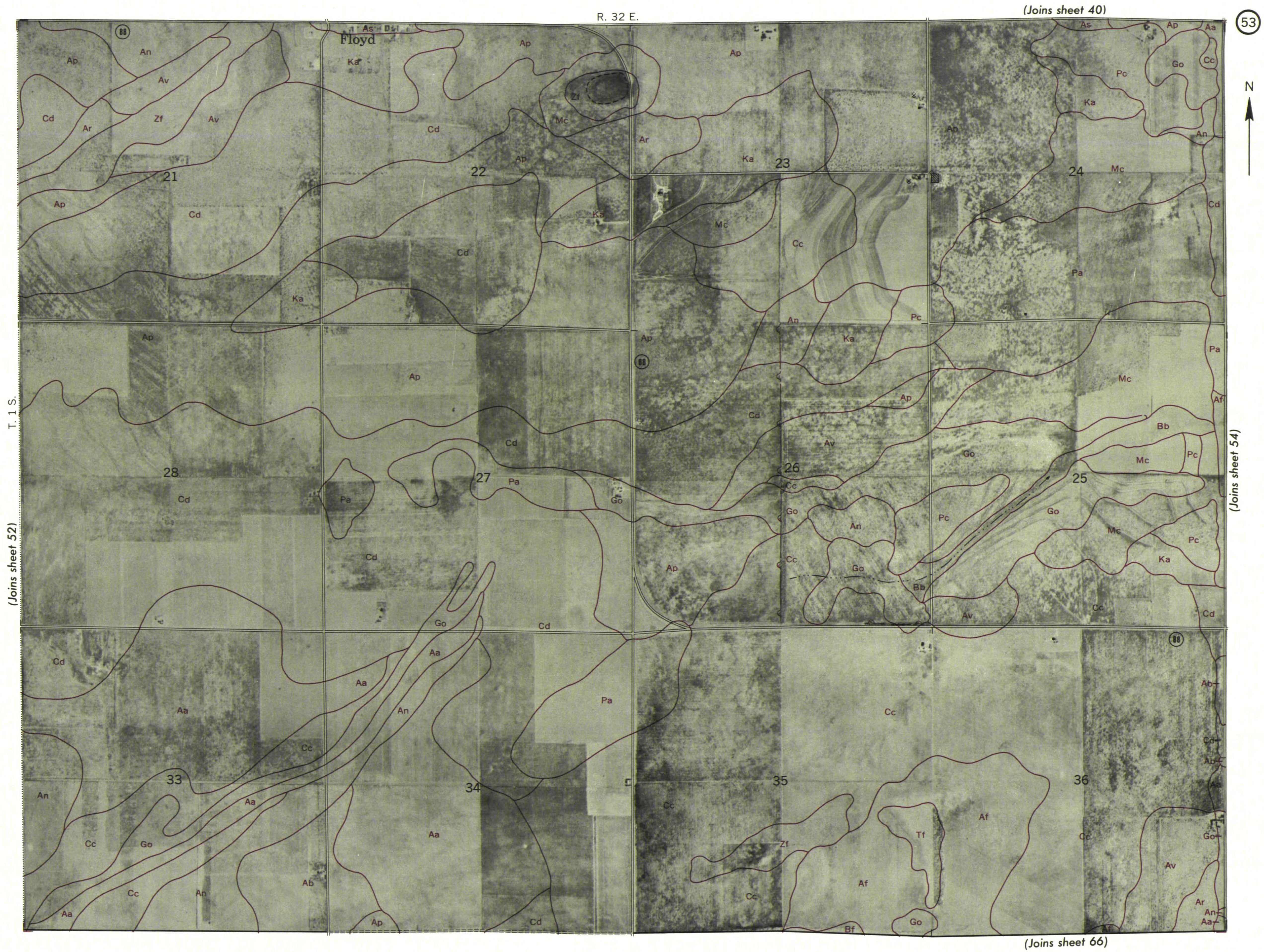
(Joins sheet 51)

(Joins sheet 53)

T. 1 S.

(Joins sheet 65)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

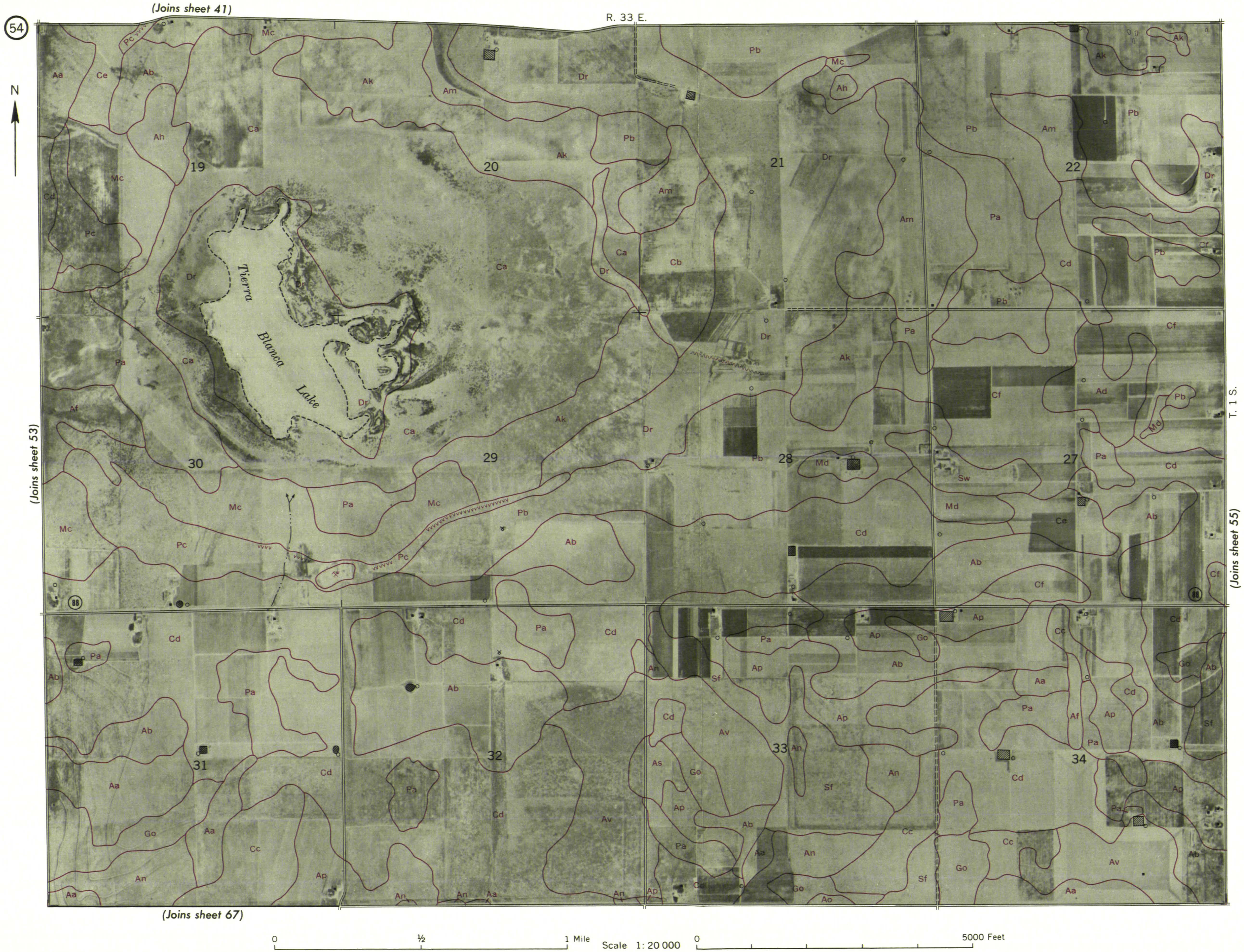


0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

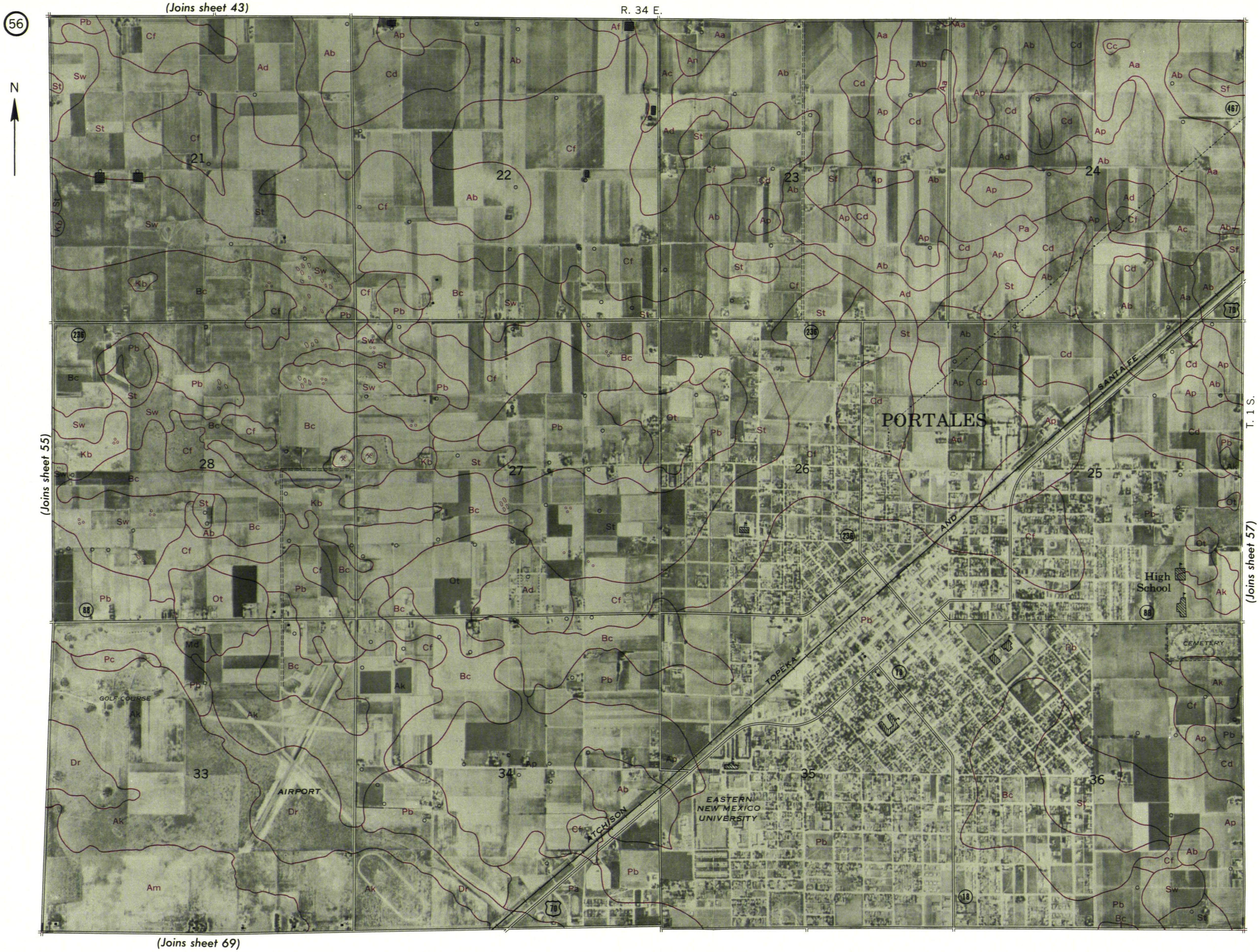
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 54



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

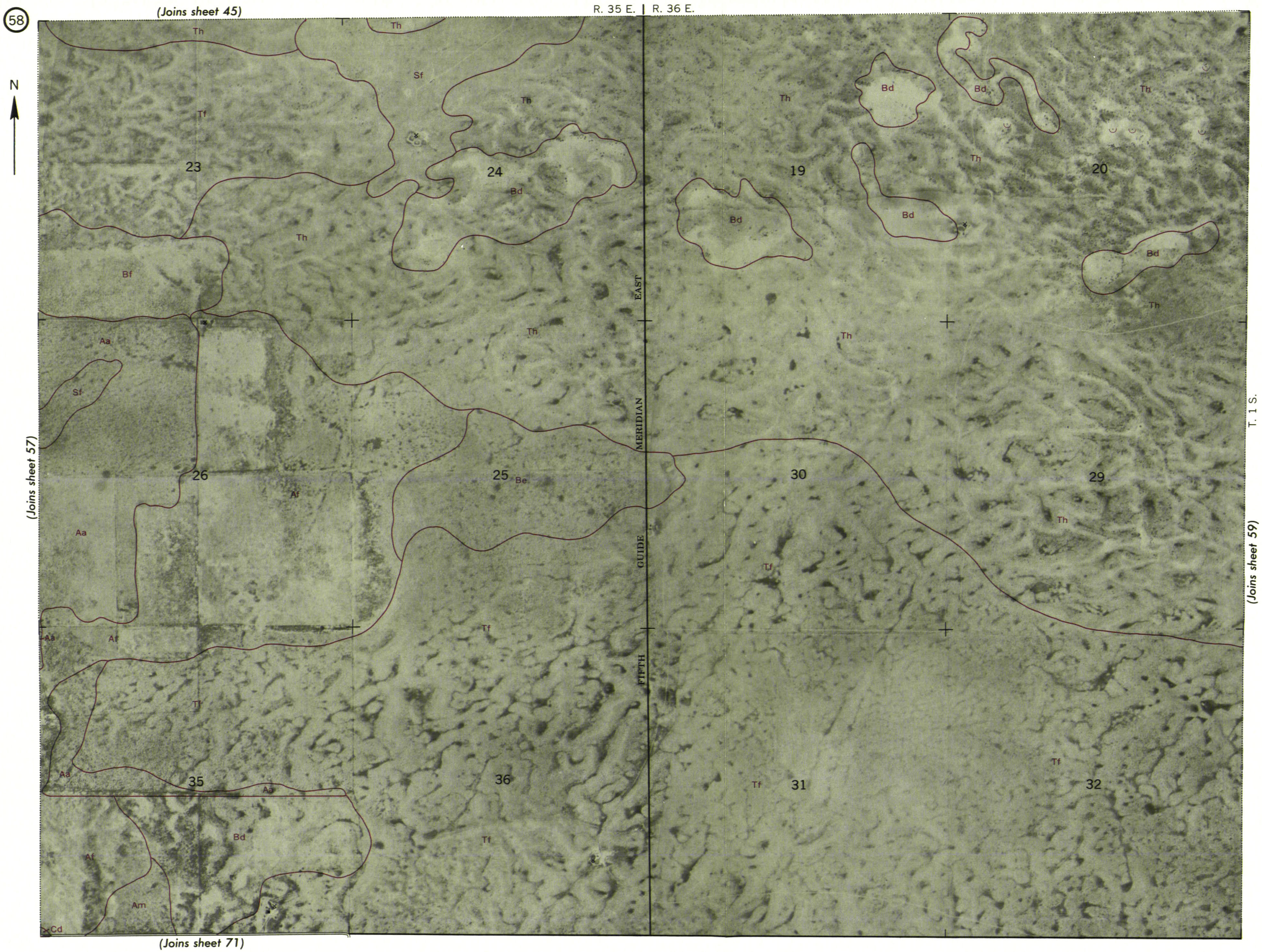


0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

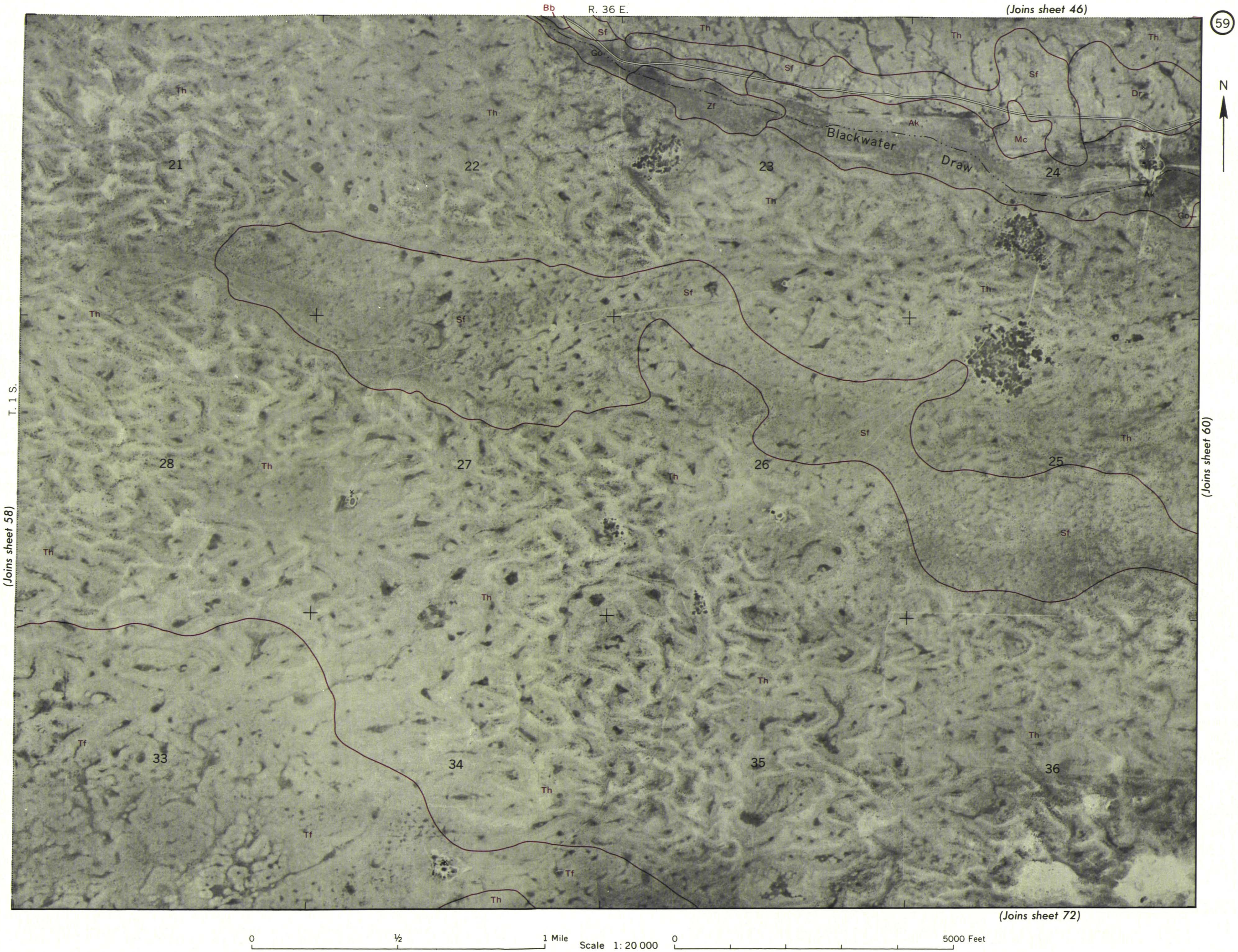
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



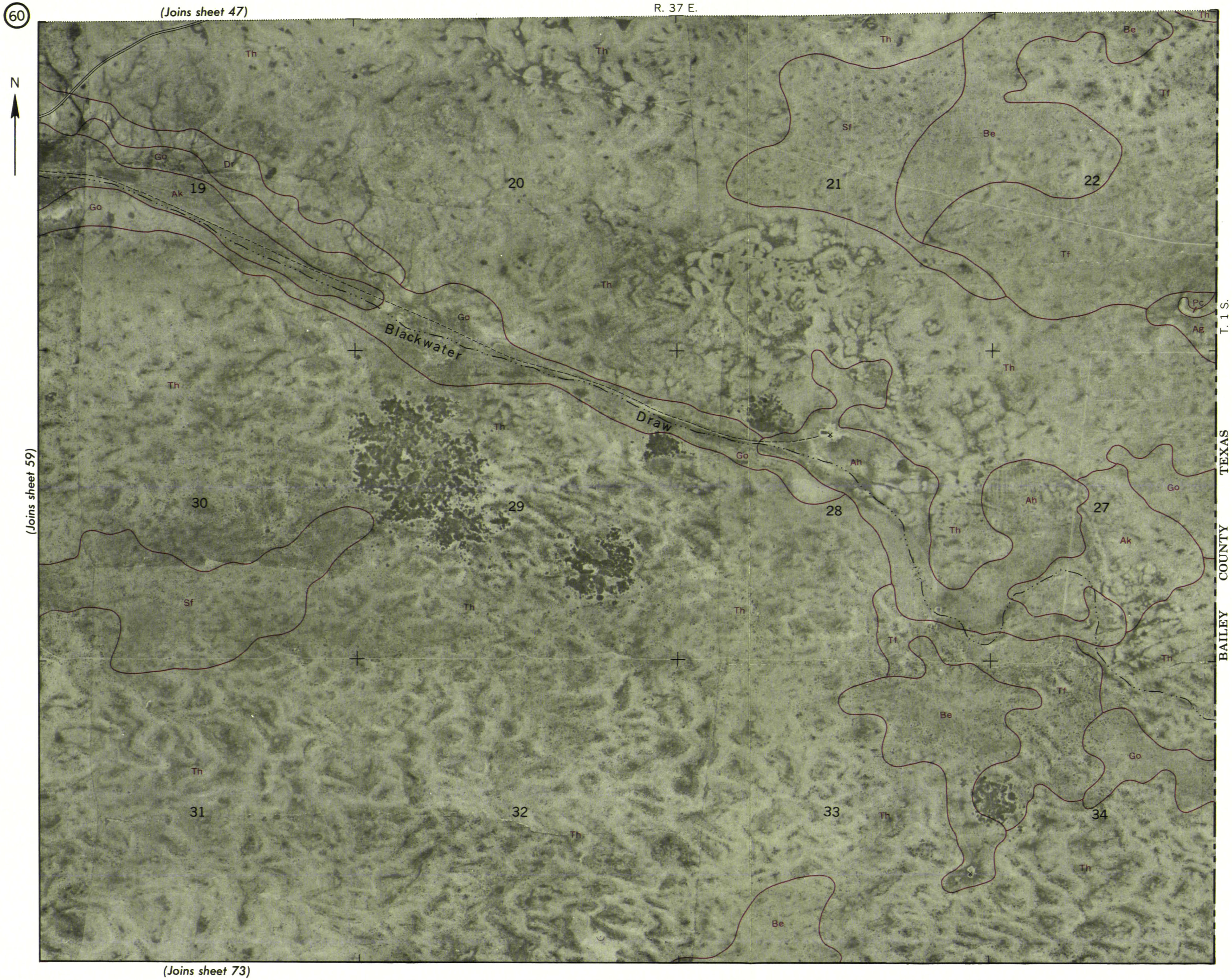
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

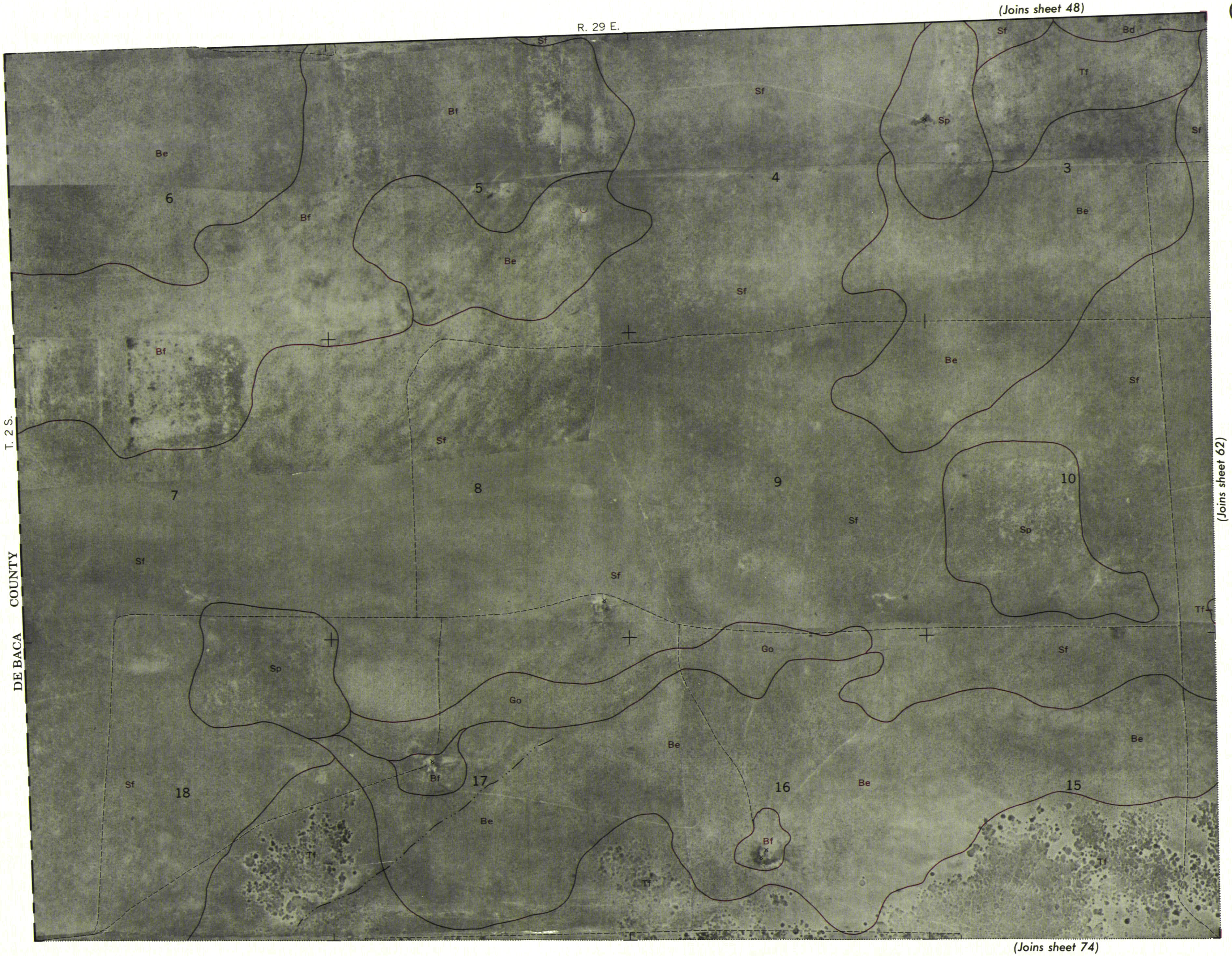
Range, township, and section corners shown on this map are indefinite


6
(Joins sheet 3)
R. 30 E.
N
(Joins sheet 5)
T. 4 N.
CURRY COUNTY
(Joins sheet 9)
Crenshaw
Alamosa Creek
21
22
23
24
25
26
27
28
33
34
35
36
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

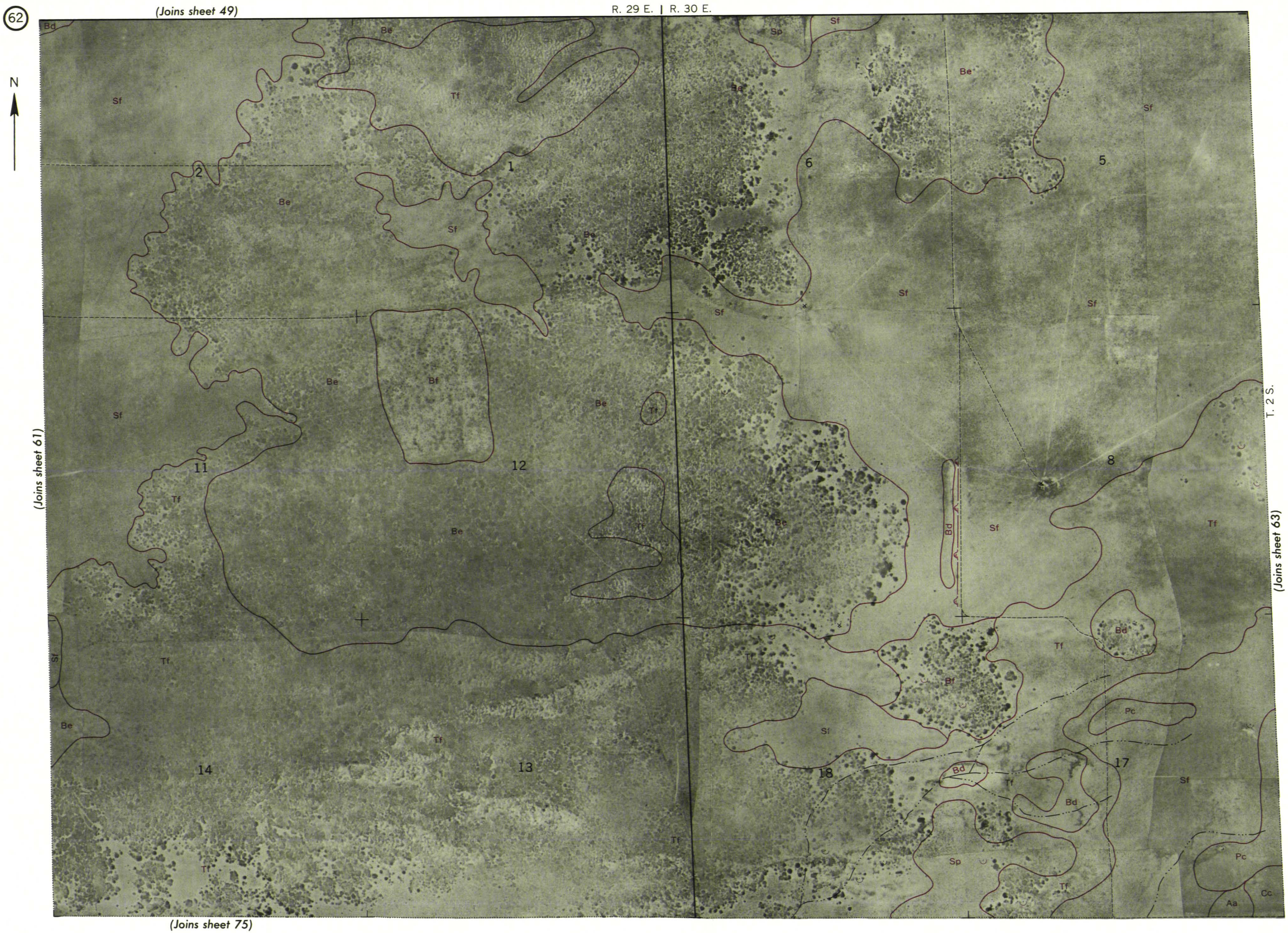
61



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

64

(Joins sheet 51)

R. 31 E.

N

(Joins sheet 63)

T. 2 S.

(Joins sheet 65)

(Joins sheet 77)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

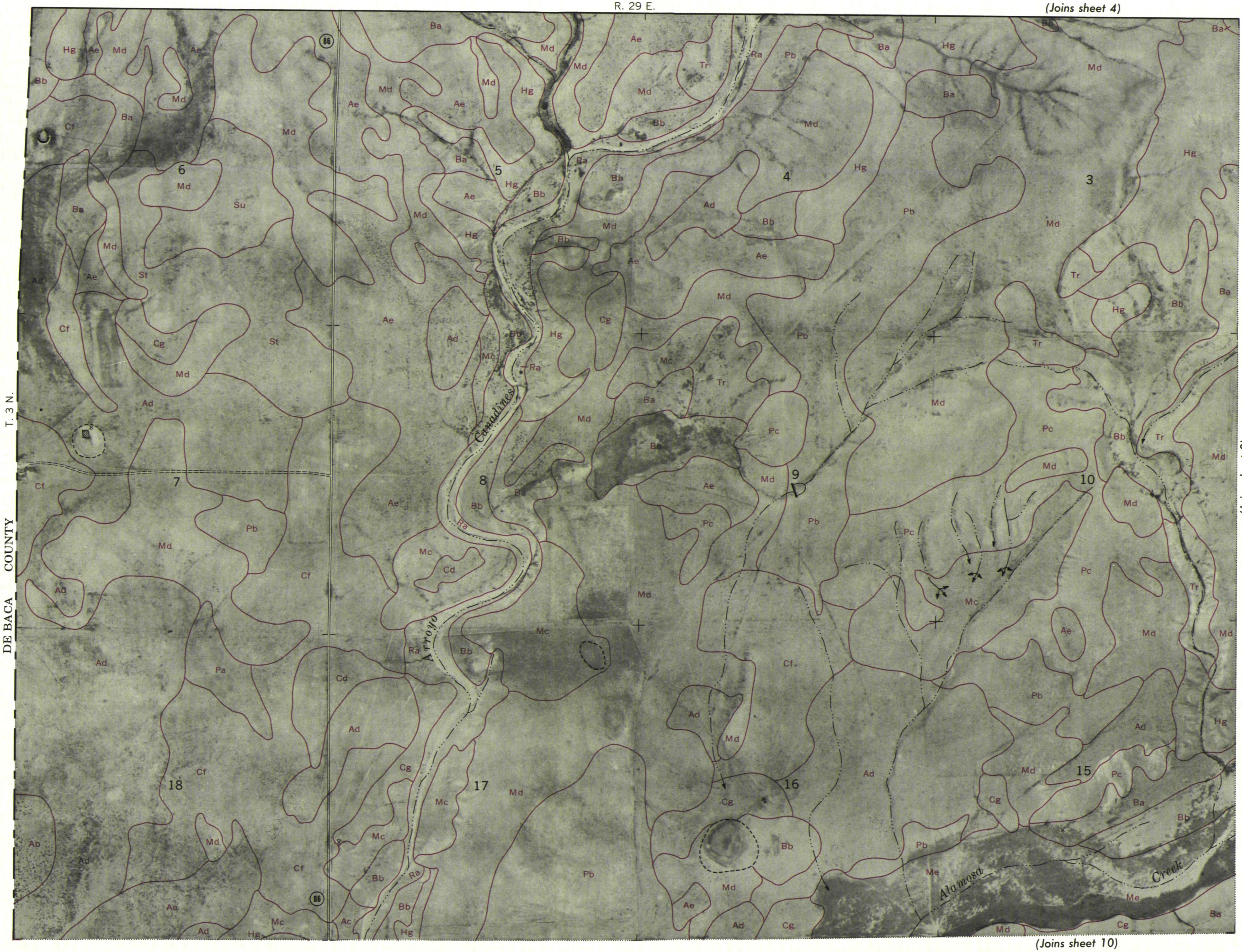
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

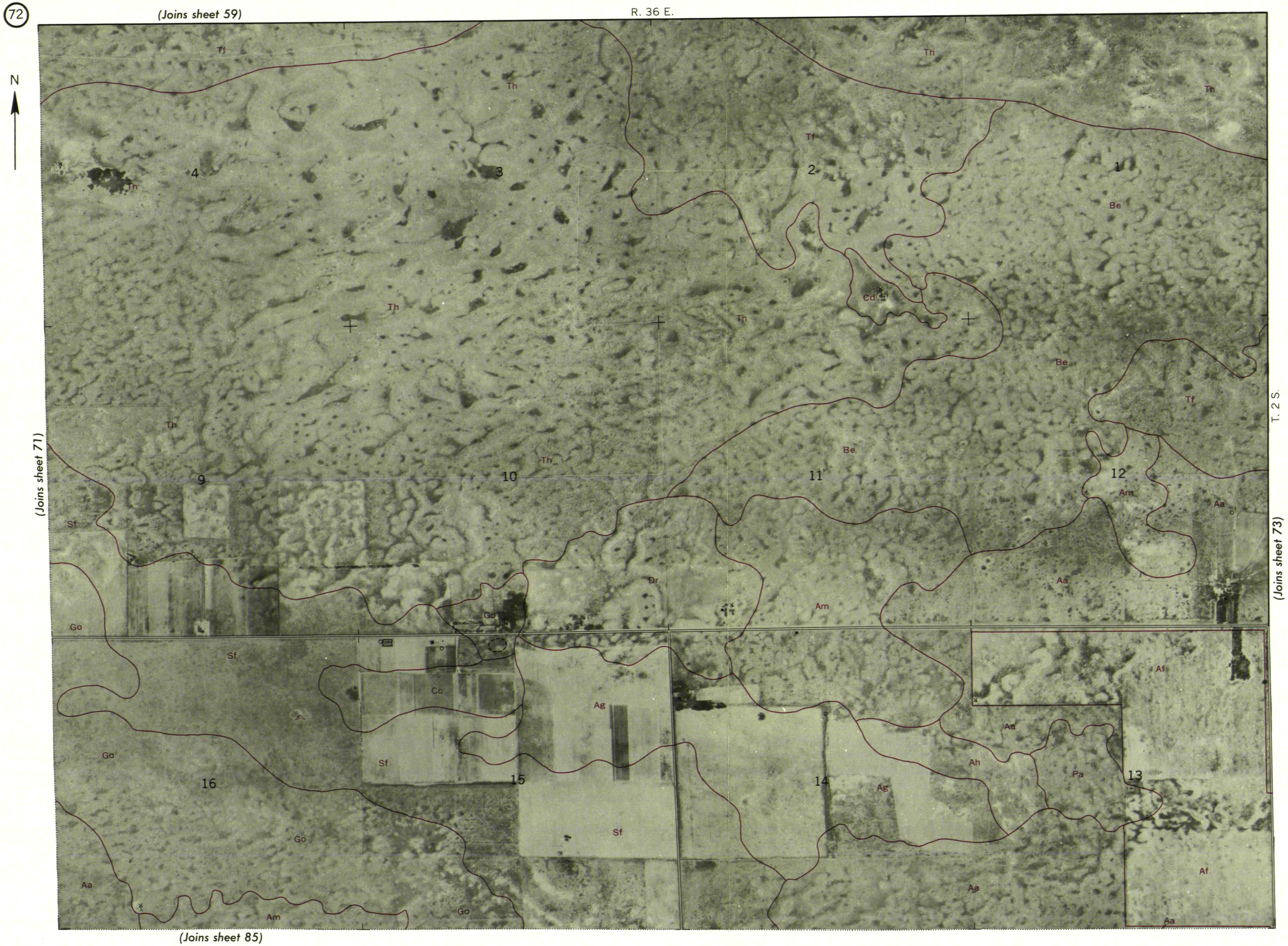
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

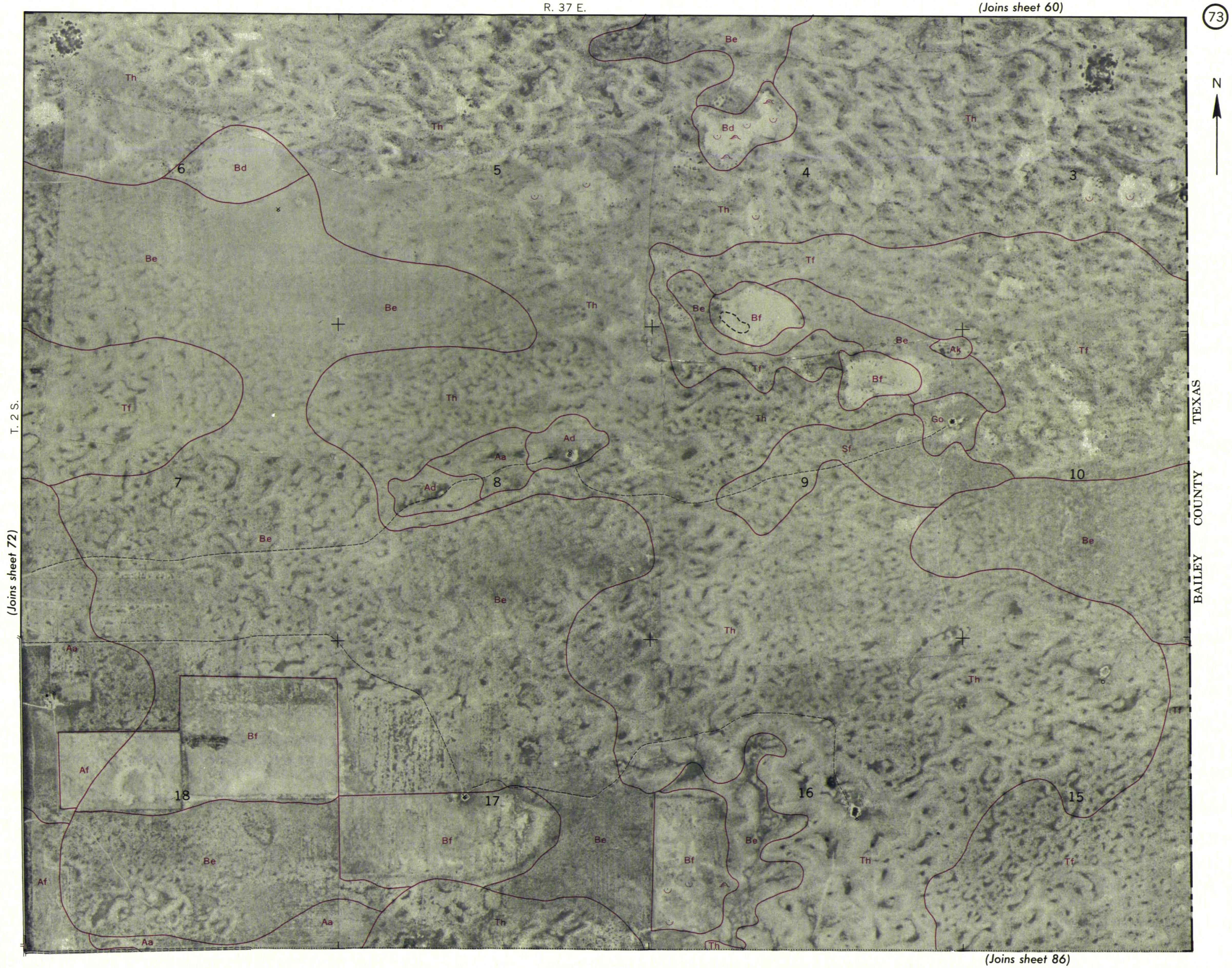
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

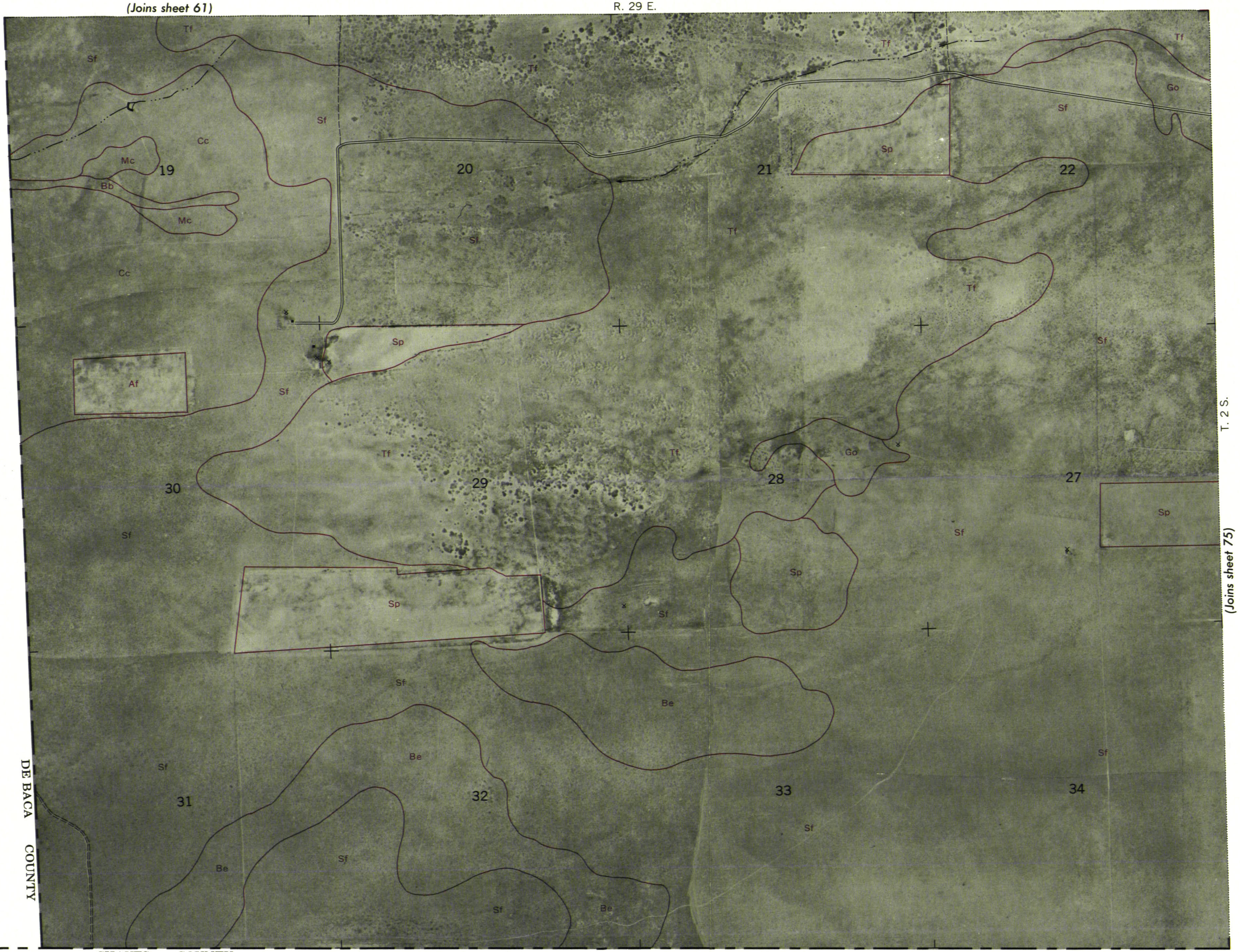
ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 74

74

(Joins sheet 61)

R. 29 E.

N



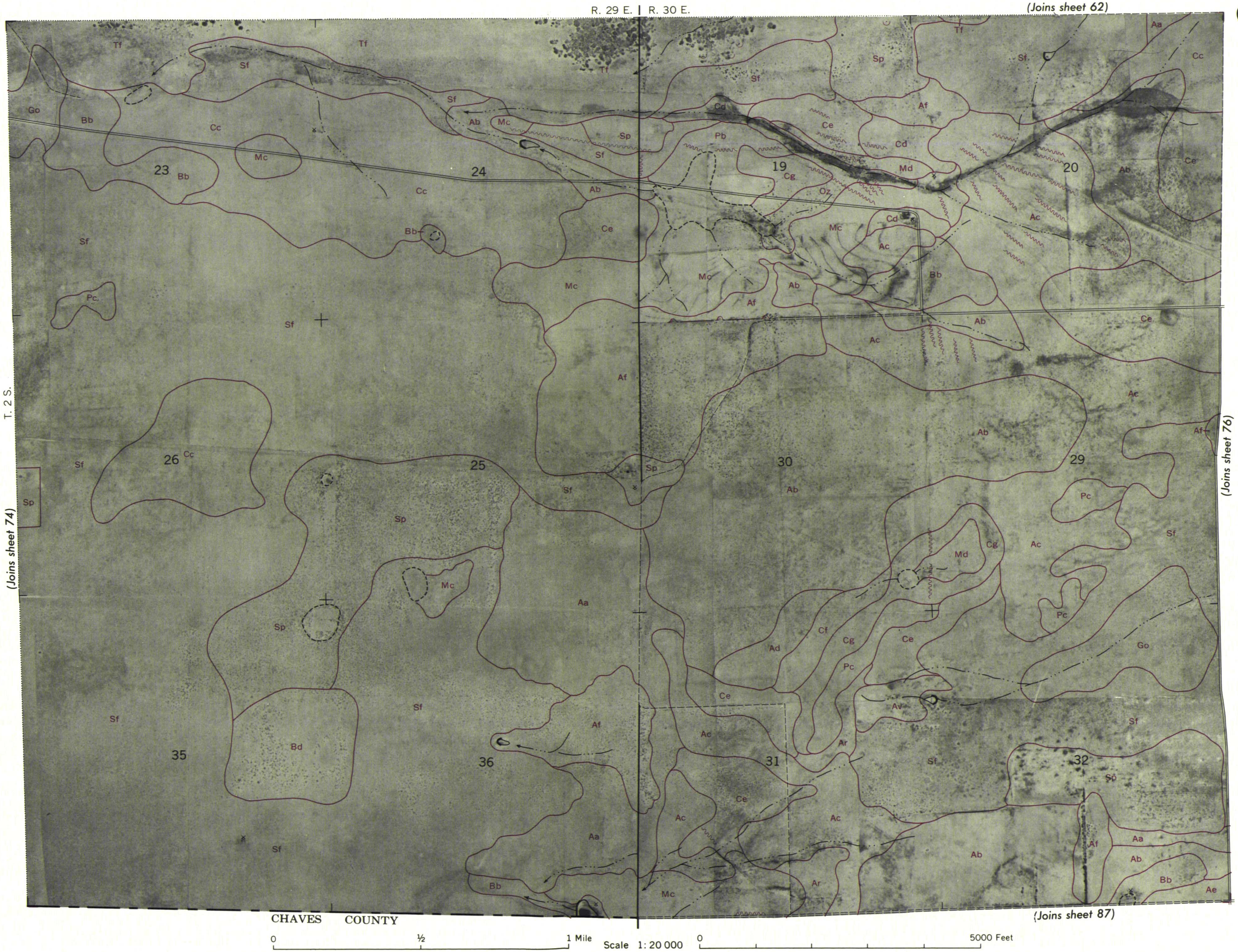
T. 2 S.

(Joins sheet 75)

DE BACA COUNTY

CHAVES COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

76

(Joins sheet 63)

R. 30 E.

N

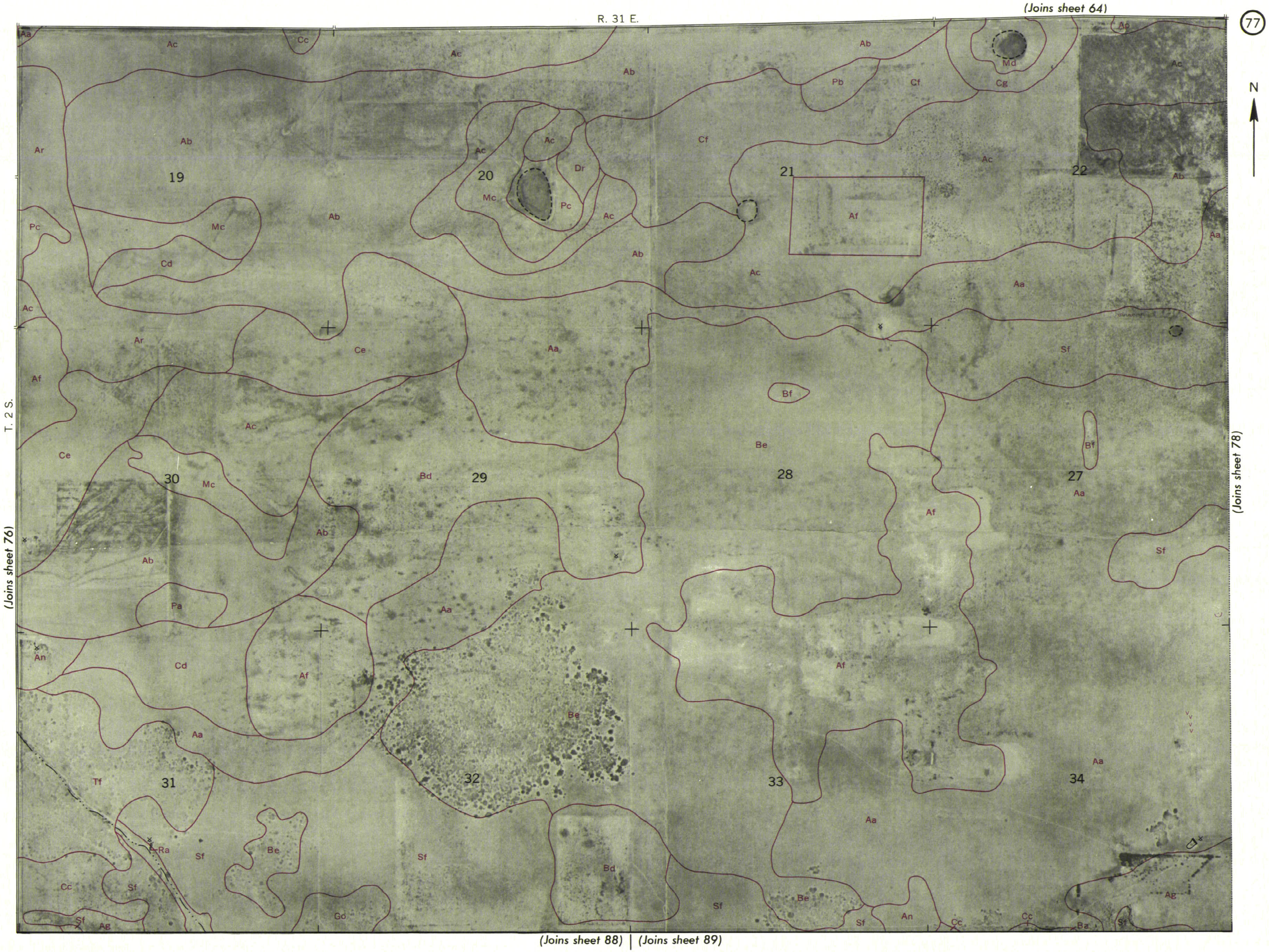
(Joins sheet 75)

T. 2 S.

(Joins sheet 77)

(Joins sheet 87) | (Joins sheet 88)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

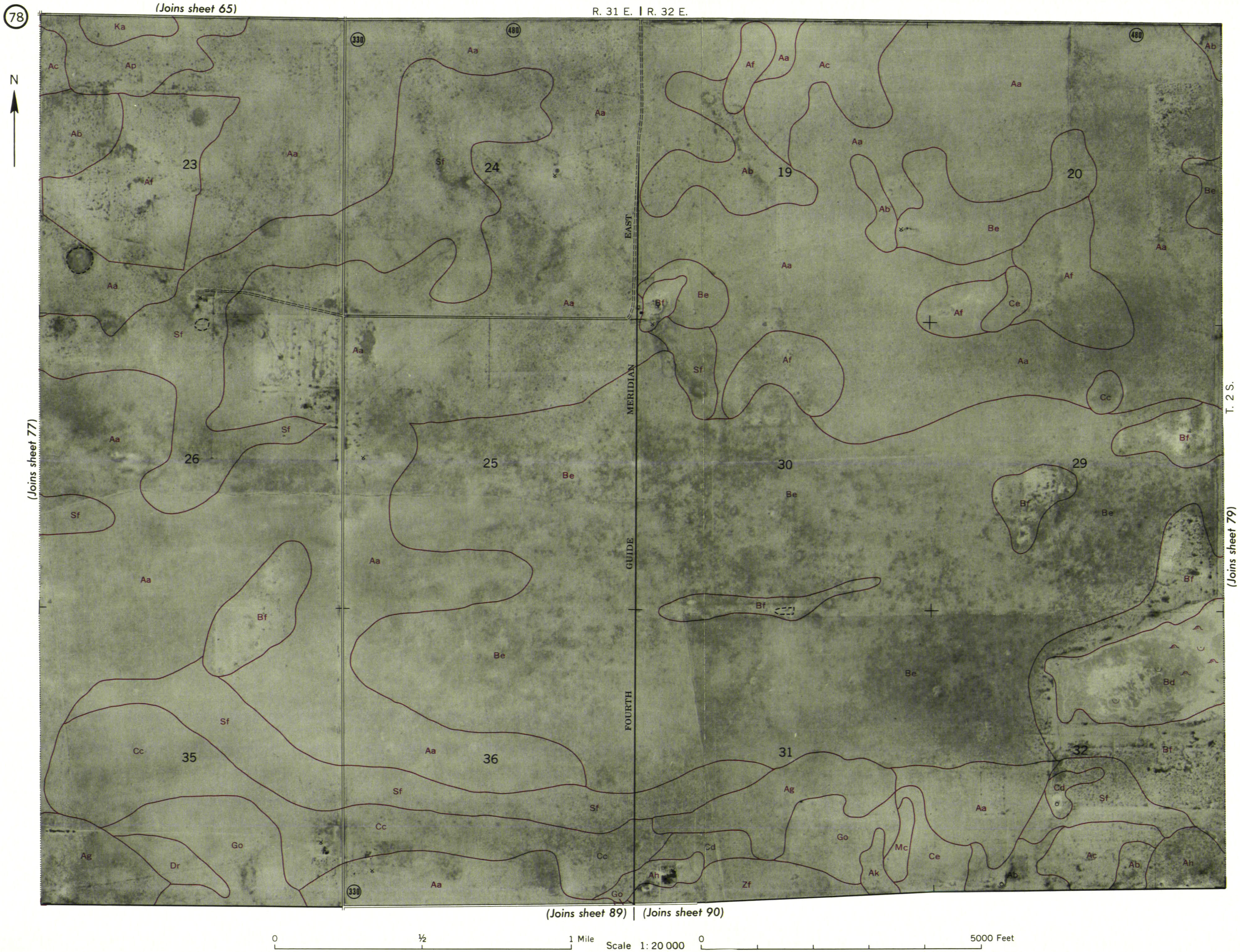


This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 78



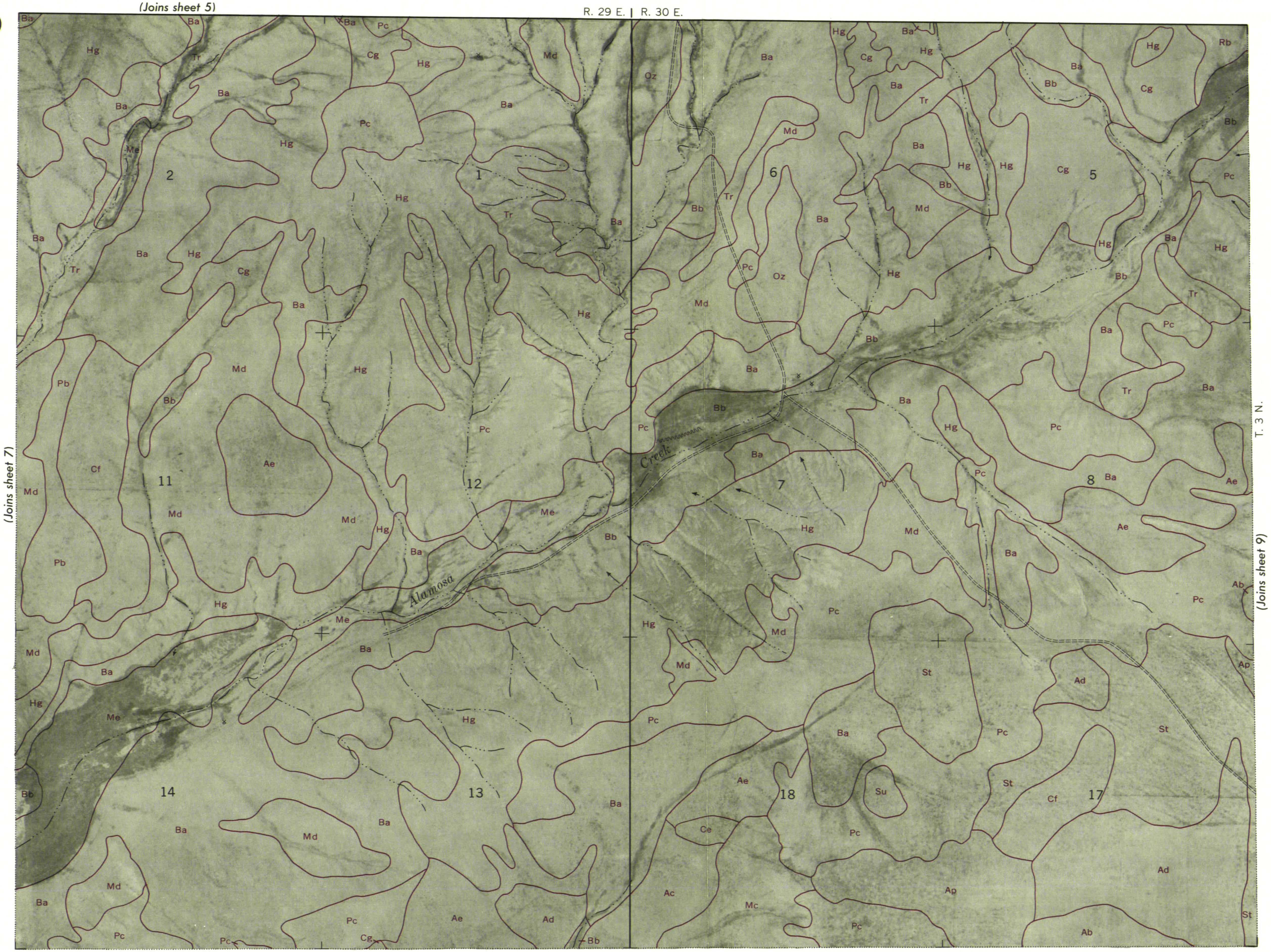
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

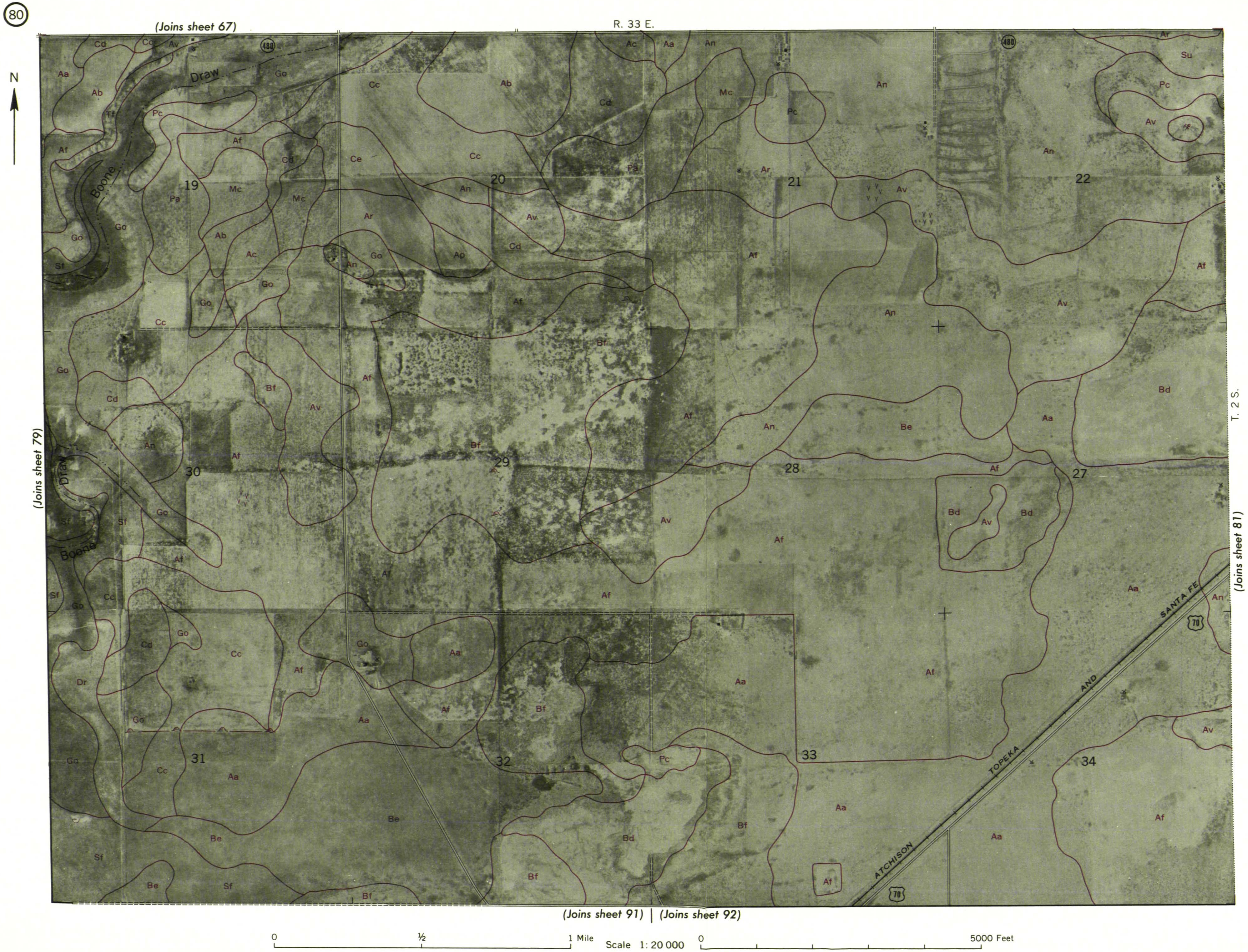
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

8

N



0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet


80
N
(Joins sheet 67)
R. 33 E.
T. 2 S.
(Joins sheet 79)
(Joins sheet 81)
(Joins sheet 91)
(Joins sheet 92)
Boone Draw
Draw
Boone
ATCHISON TOPEKA AND SANTA FE
480
70
19
20
21
22
30
29
28
27
31
32
33
34
Aa Ab Ac Af An Ap Ar Av Bd Be Bf Cc Cd Ce Dr Go Mc Pa Pc Sf Su Tf
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 70)

83

(Joins sheet 82)

(Joins sheet 84)

(Joins sheet 94) | (Joins sheet 95)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

86

(Joins sheet 73)

R. 37 E.

N

T. 2 S.

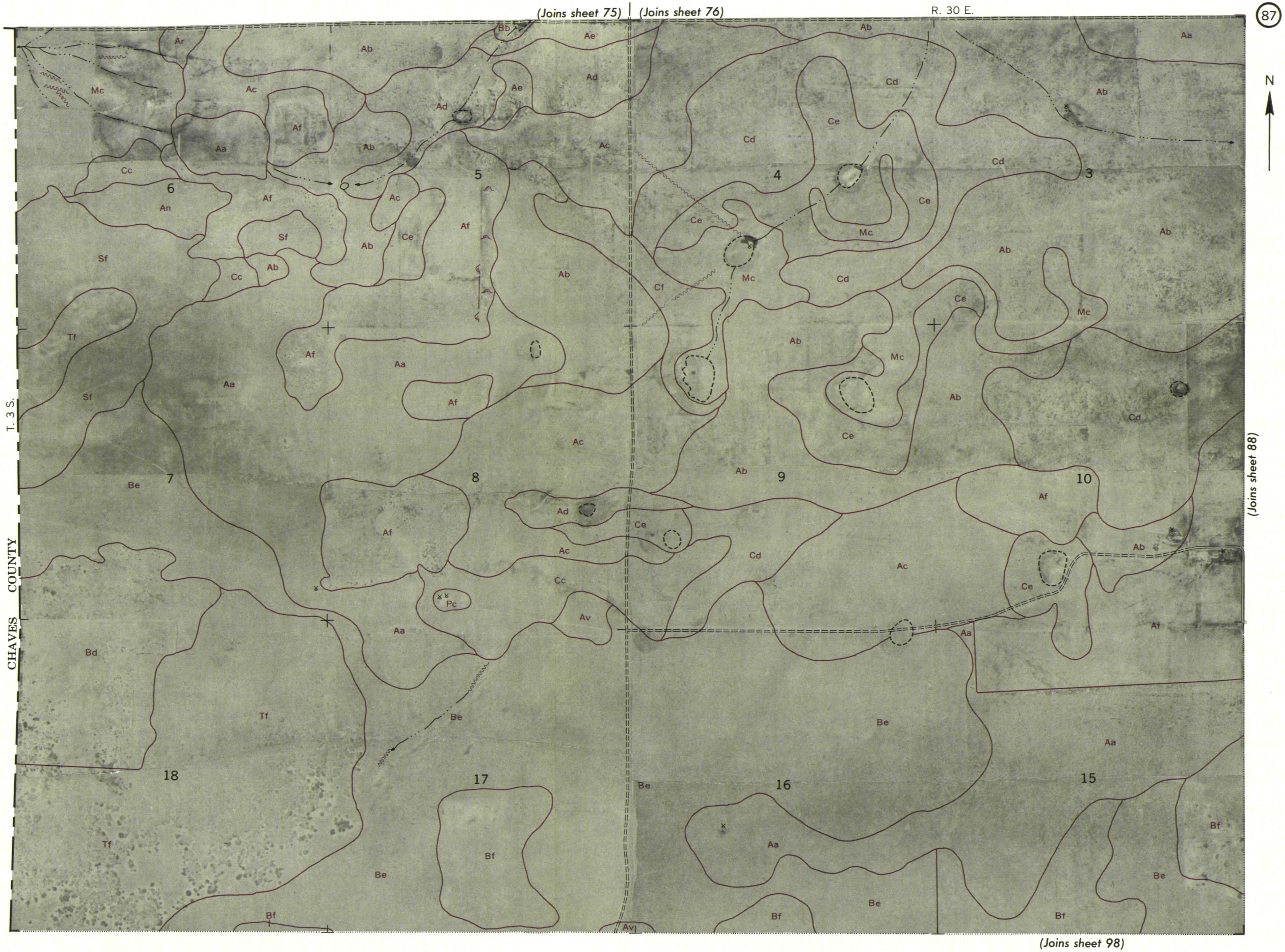
TEXAS

BAILEY COUNTY

(Joins sheet 85)

(Joins sheet 97) | (Joins inset, sheet 109)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 88

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

9

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 90

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

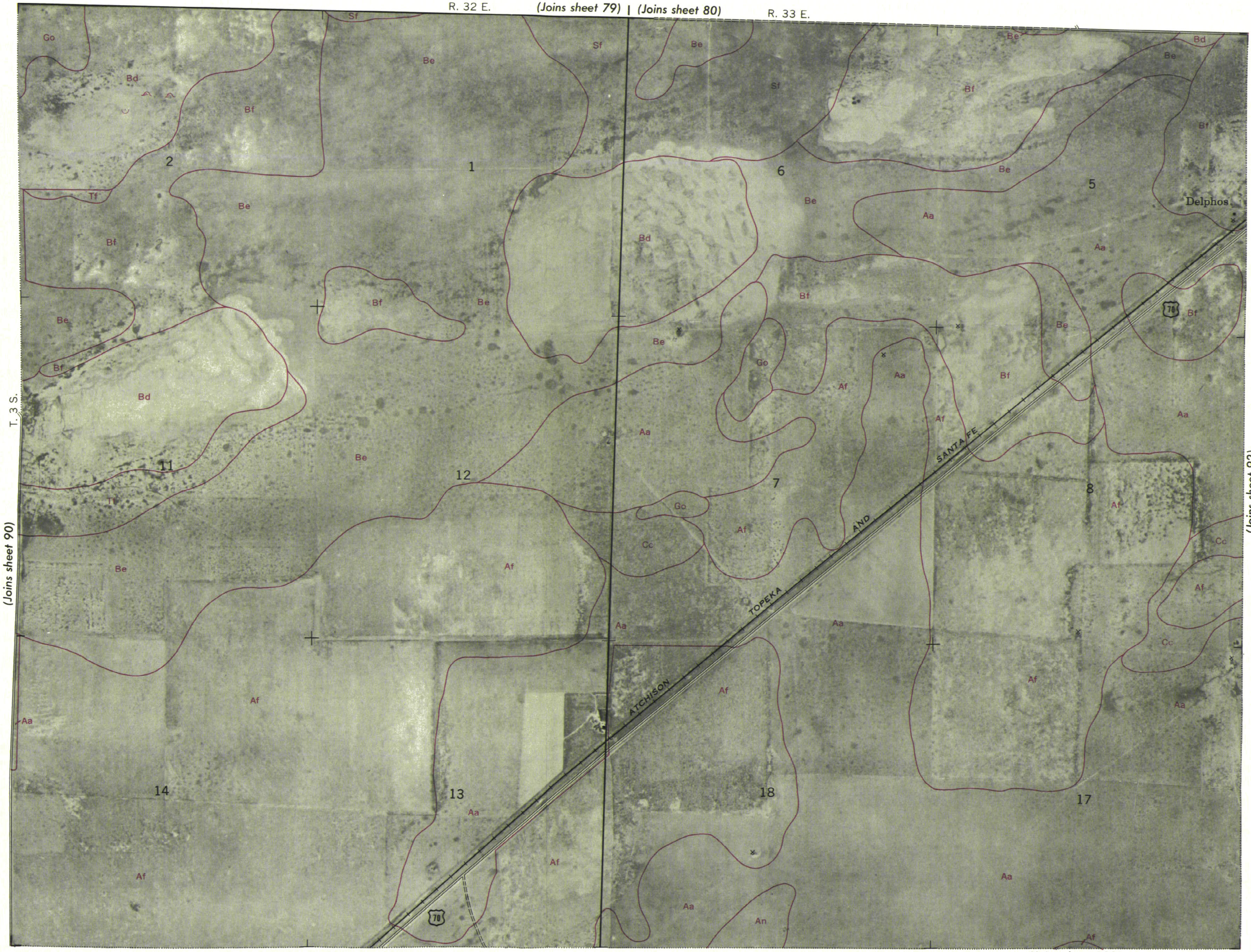
R. 32 E. (Joins sheet 79) | (Joins sheet 80) R. 33 E.

91

N

T. 3 S.

(Joins sheet 90)



(Joins sheet 92)

(Joins sheet 102)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

ROOSEVELT COUNTY, NEW MEXICO — SHEET NUMBER 92

92

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

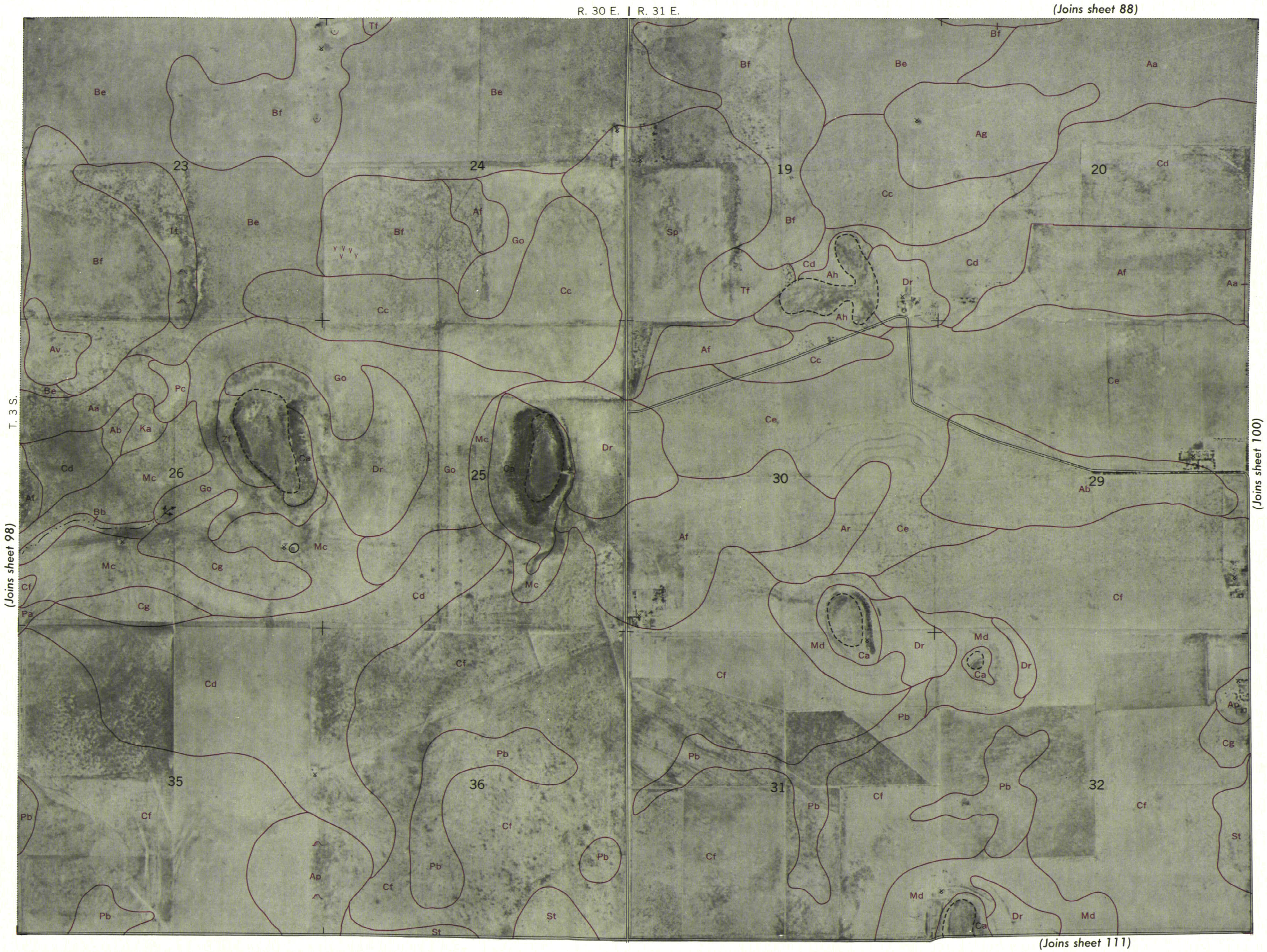
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

98


(Joins sheet 87)
R. 30 E.
N
CHAVES COUNTY
T. 3 S.
(Joins sheet 99)
(Joins sheet 110)
19
20
21
22
27
28
29
30
31
32
33
34
Tf
Be
Bf
Av
An
Aa
Af
Cc
Go
Cd
Ce
Pa
Dr
Ad
Mc
Bb
Zf
Ab
Ap
Md
Cf
St
Su
Pb
0 ½ 1 Mile
Scale 1: 20 000
0 5000 Feet

99



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite

GUIDE TO MAPPING UNITS

[See table 1, page 5, for acreage and proportionate extent of soils; see table 2, page 28, for estimated yields of principal dryfarmed crops, and table 4, page 34, for estimated yields of irrigated crops; see table 5, page 40, table 6, page 46, and table 7, page 56, for engineering properties of the soils]

Map symbol	Mapping unit	Described on page	Dryland capability unit: Climatic zone 3 Symbol	Page	Dryland capability unit: Climatic zone 4 Symbol	Page	Irrigated capability unit Symbol	Page	Range site Name	Page
Aa	Amarillo loamy fine sand, 0 to 3 percent slopes	4	IVe-4	25	VIe-1	26	IIIe-10	31	Sandy Upland	36
Ab	Amarillo fine sandy loam, 0 to 1 percent slopes	5	IIIe-1	23	IVe-1	24	IIe-2	30	Sandy Upland	36
Ac	Amarillo fine sandy loam, 1 to 3 percent slopes	5	IIIe-1	23	IVe-1	24	IIIe-4	31	Sandy Upland	36
Ad	Amarillo loam, 0 to 1 percent slopes	6	IIIce-1	24	IVce-1	25	IIe-1	29	Loamy Upland	34
Ae	Amarillo loam, 1 to 3 percent slopes	6	IIIce-1	24	IVce-1	25	IIIe-3	31	Loamy Upland	34
Af	Amarillo and Clovis soils, 0 to 3 percent slopes, severely eroded	6	VIe-1	26	VIe-1	26	IVe-8	32	Sandy Upland	36
Ag	Arch loamy fine sand	7	VIe-3	26	VIe-3	26	IVe-11	32	Sandy Plains	36
Ah	Arch fine sandy loam	7	VIe-2	26	VIe-2	26	IVe-9	32	Limy Upland	35
Ak	Arch loam	7	VIe-2	26	VIe-2	26	IVe-9	32	Limy Upland	35
Am	Arch soils, severely eroded	8	VIe-2	26	VIe-2	26	(None)	--	Limy Upland	35
An	Arvana loamy fine sand, 0 to 3 percent slopes	8	IVe-4	25	VIe-1	26	IVe-6	32	Sandy Upland	36
Ao	Arvana loamy fine sand, shallow, 0 to 1 percent slopes	8	VIe-1	26	VIe-1	26	(None)	--	Sandy Upland	36
Ap	Arvana fine sandy loam, 0 to 1 percent slopes	8	IIIe-2	24	IVe-6	25	IIe-9	30	Sandy Upland	36
Ar	Arvana fine sandy loam, 1 to 3 percent slopes	8	IIIe-2	24	IVe-6	25	IIIe-7	31	Sandy Upland	36
As	Arvana fine sandy loam, shallow, 0 to 1 percent slopes	9	VIe-1	26	(None)	--	IVe-13	33	Sandy Upland	36
Av	Arvana soils, 0 to 3 percent slopes, severely eroded	9	VIIs-1	27	VIIs-1	27	(None)	--	Shallow Upland	37
Ba	Berthoud sandy loam, 2 to 9 percent slopes	9	VIe-1	26	VIe-1	26	(None)	--	Sandy Upland	36
Bb	Bippus and Spur soils	9	VIw-3	27	VIw-3	27	(None)	--	Loamy Bottomland	36
Bc	Blackwater loam	10	IIIce-2	24	(None)	--	IIe-5	30	Loamy Upland	34
Bd	Blown-out and dune land	10	VIIe-1	27	VIIe-1	27	(None)	--	Deep Sand	37
Be	Brownfield fine sand	10	VIe-3	26	VIe-3	26	(None)	--	Sandy Plains	36
Bf	Brownfield soils, severely eroded	11	VIIe-1	27	VIIe-1	27	(None)	--	Deep Sand	37
Ca	Church clay loam	11	VIw-2	27	VIw-2	27	IIIe-11	32	Salt Flats	35
Cb	Church soils, severely eroded	11	VIw-2	27	VIw-2	27	(None)	--	Salt Flats	35
Cc	Clovis loamy fine sand, 0 to 3 percent slopes	11	IVe-4	25	VIe-1	26	IVe-6	32	Sandy Upland	36
Cd	Clovis fine sandy loam, 0 to 1 percent slopes	11	IIIe-2	24	IVe-6	25	IIe-9	30	Sandy Upland	36
Ce	Clovis fine sandy loam, 1 to 3 percent slopes	12	IIIe-2	24	IVe-6	25	IIIe-7	31	Sandy Upland	36
Cf	Clovis loam, 0 to 1 percent slopes	12	IIIce-2	24	IVce-2	25	IIe-3	30	Loamy Upland	34
Cg	Clovis loam, 1 to 3 percent slopes	12	IIIce-2	24	IVce-2	25	IIIe-6	31	Loamy Upland	34
Dr	Drake soils	13	VIe-2	26	VIe-2	26	IVe-12	33	Limy Upland	35
Go	Gomez loamy fine sand	13	VIe-3	26	VIe-3	26	IVe-11	32	Sandy Plains	36
Hg	Hilly gravelly land	13	VIIs-2	27	VIIs-2	27	(None)	--	Gravelly Upland	35
Ka	Kimbrough fine sandy loam	13	VIIs-1	27	VIIs-1	27	(None)	--	Shallow Upland	37
Kb	Kimbrough loam	14	VIIs-1	27	VIIs-1	27	(None)	--	Shallow Upland	37
Mc	Mansker and Portales fine sandy loams, 1 to 3 percent slopes	14								
	Mansker fine sandy loam	--	IVe-3	25	VIe-2	26	IVe-7	32	Limy Upland	35
	Portales fine sandy loam	--	IVe-3	25	VIe-1	26	IIIe-7	31	Sandy Upland	36
Md	Mansker and Portales loams, 1 to 3 percent slopes	14								
	Mansker loam	--	IVe-2	24	VIe-2	26	IVe-7	32	Limy Upland	35
	Portales loam	--	IVe-2	24	IVce-2	25	IIIe-6	31	Loamy Upland	34
Me	Montoya clay loam	15	VIw-1	26	VIw-1	26	(None)	--	Valley Clay	36
Ot	Olton loam, 0 to 1 percent slopes	15	IIIce-1	24	IVce-1	25	IIe-4	30	Loamy Upland	34
Oz	Olton-Zita loams, 0 to 1 percent slopes	15								
	Olton loam	--	IIIce-1	24	IVce-1	25	IIe-4	30	Loamy Upland	34
	Zita loam	--	IIIce-2	24	IVce-2	25	IIe-3	30	Loamy Upland	34
Pa	Portales fine sandy loam, 0 to 1 percent slopes	16	IVe-3	25	VIe-1	26	IIe-9	30	Sandy Upland	36
Pb	Portales loam, 0 to 1 percent slopes	16	IVe-2	24	IVce-2	25	IIe-3	30	Loamy Upland	34
Pc	Potter soils, 0 to 9 percent slopes	16	VIIs-1	27	VIIs-1	27	(None)	--	Shallow Upland	37
Ra	Riverwash	16	VIIIw-1	27	VIIIw-1	27	(None)	--	(None)	--
Rb	Rough broken land	16	VIIs-1	27	VIIs-1	27	(None)	--	Shallow Upland	37
Sf	Springer loamy fine sand	16	VIe-3	26	VIe-3	26	IVe-8	32	Sandy Plains	36
Sp	Springer soils, severely eroded	17	VIe-3	26	VIe-3	26	(None)	--	Sandy Plains	36
St	Stegall loam, 0 to 1 percent slopes	17	IIIce-2	24	IVce-2	25	IIe-4	30	Loamy Upland	34
Su	Stegall loam, 1 to 3 percent slopes	17	IIIce-2	24	IVce-2	25	IIIe-6	31	Loamy Upland	34
Sw	Stegall loam, shallow, 0 to 1 percent slopes	17	VIe-4	26	(None)	--	IVe-13	33	Loamy Upland	34
Tf	Tivoli fine sand	17	VIIe-1	27	VIIe-1	27	(None)	--	Deep Sand	37
Th	Tivoli-Arch complex	18								
	Tivoli fine sand	--	VIIe-1	27	(None)	--	(None)	--	Deep Sand	37
	Arch fine sandy loam	--	VIe-2	26	(None)	--	IVe-9	32	Limy Upland	35
Tr	Travessilla loam	18	VIIs-1	27	VIIs-1	27	(None)	--	Shallow Upland	37
Zf	Zita fine sandy loam, 0 to 1 percent slopes	18	IIIe-2	24	IVe-6	25	IIe-9	30	Sandy Upland	36
Zm	Zita loam, 0 to 1 percent slopes	19	IIIce-2	24	IVce-2	25	IIe-3	30	Loamy Upland	34